INSTRUCTION MANUAL

CKT Study

SN

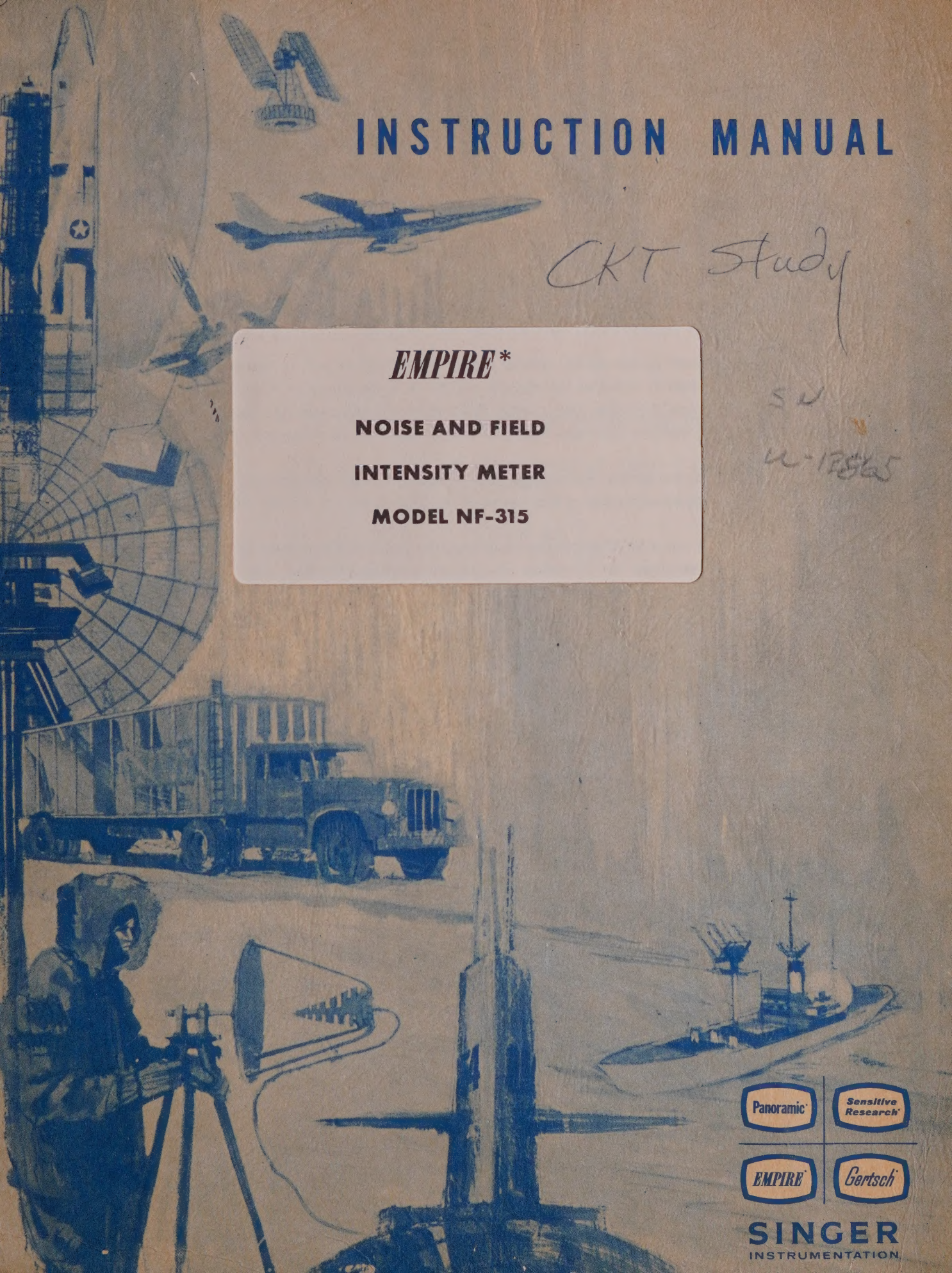
4-1F5625

*EMPIRE**

NOISE AND FIELD

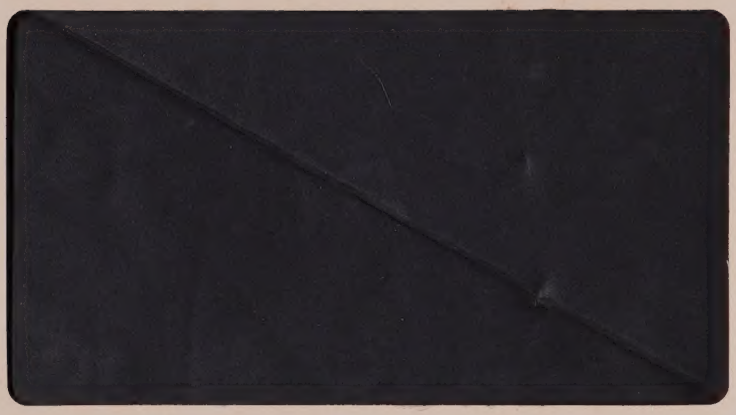
INTENSITY METER

MODEL NF-315



Panoramic · Sensitive Research · EMPIRE · Gertsch

SINGER
INSTRUMENTATION



INSTRUCTION MANUAL

*EMPIRE**

NOISE AND FIELD

INTENSITY METER

MODEL NF-315

SERIAL NO. [redacted]

Instruction Manual No. 110-5013

(EFFECTIVITY: Serial Nos. U14115 through U14135 and U15427 & up.)

SINGER
INSTRUMENTATION

Precision electrical and electronic instruments for measurement

emc — EMPIRE* — Gertsch* — Panoramic* — Sensitive Research*

THE SINGER COMPANY • METRICS DIVISION

* *A Trademark of THE SINGER COMPANY

WARRANTY

THE SINGER COMPANY, METRICS DIVISION, warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

*Sensitive Research** Electrical Indicating Instruments.....2 years
Other Electrical and Electronic Measuring Instruments.....1 year

Repair or replacement (at our option) without charge (F.O.B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and *RatioTran** potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other obligations or liabilities expressed or implied and The Singer Company neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of instruments manufactured by The Singer Company, Metrics Division.

THE SINGER COMPANY • METRICS DIVISION
915 PEMBROKE STREET, BRIDGEPORT, CONNECTICUT • 3211 S. LA CIENEGA BLVD., LOS ANGELES, CALIFORNIA

*A Trademark of THE SINGER COMPANY

REPAIR AND MAINTENANCE

Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Warranty repair will be made upon written request. Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(2)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Contact Metrics Division, Bridgeport, Connecticut for *Empire**, *Panoramic**, and *Sensitive Research** instruments. Contact Metrics Division, Los Angeles, California for *Gertsch** instruments.

(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

ADDENDUM

for

MODEL NF-315

I. PURPOSE.

This addendum is to correct errors in the instruction manual.

II. ADDENDUM.

Incorporate the following changes into the instruction manual.

a. In figure 3-3, change the pin numbering of wafer c of WIDE BAND attenuator switch A2S1 as follows:

change	pin	16	to	read	pin	9
"	"	15	"	"	"	16
"	"	14	"	"	"	15
"	"	13	"	"	"	14
"	"	12	"	"	"	13
"	"	11	"	"	"	12
"	"	10	"	"	"	11
"	"	9	"	"	"	10

b. In table 4-16, change the nominal emitter and base voltage of Q1 to read -0.75 and -0.7, respectively.

c. In figure 5-3, change the value of R3 from 27K to 15K and change the value of R11 from 220 to 47.

d. In figure 5-7, add a connector terminal at the junction of chassis ground, R1, J1-1 and C7. Label this terminal "GRD".

e. In figure 5-10, change Q2, 2N404 to read Q3, 2N404. Change the voltage value at R15 from -12V to 12.7V.

f. In figure 5-15, delete capacitors A6A1C1 and A6A1C2 (both 100 uf, 15V). Change the legend at J1-E to read +30V. Change the legend J1-D to read -30V. Delete the line from S1A-2 to the junction of CR-6, S1A-5, S1A-6, collector of Q3 and terminals 37 and 38 of A6A1.

Addendum No. E19

ADDENDUM

for

MODEL NF-315

I. PURPOSE.

To correct existing errors in technical manual.

II. ADDENDUM.

1. Change the last sentence of paragraph 3-15 to read: "Resistor A1R12, which is ....."

2. Change the "Procedure" column of Table 4-3, step 33, to read: "Connect a digital voltmeter between terminals D and F of the REMOTE INDICATOR connector. Rotate the FREQUENCY TUNING control throughout the band and note the voltmeter indication".

3. Change the "Acceptable Indication" column of Table 4-3, step 33, to read: ".... from 0 to +10 volts (±5%)....."

Addendum No. E25

ADDENDUM

for

MODEL NF-315

I. PURPOSE.

To reflect latest changes in components.

II. ADDENDUM.

A. In table 1-7:
   (1) Change A5A1CR1 diode type from CGD1460 to 1N251.
   (2) Change A5A1Q5 and A6A1Q7 transistor types from 2N1306 to 2N2270.

B. In figure 5-3, change value of C6 from 1500 to 100.

C. In figure 5-10:
   (1) Change CR1 diode type from CGD1460 to 1N251.
   (2) Change Q5 and Q7 diode types from 2N1306 to 2N2270.
   (3) Add R22 (47K) across C7.

D. In table 6-2:
   (1) Change F1 description to read: "FUSE, 1/4 AMP, DELAY SINGER PART NO. 556006-113."
   (2) Change F1 manufacturer's part number to read: "315.250".
   (3) Change J5 Singer Part No. to read: "556010-057."
   (4) Change J5 manufacturer's part number to read: "126-218."
   (5) Add:

A5A1CR1	SEMICONDUCTOR DEVICE, DIODE SINGER PART NO. 99-556118-046	1N251	81349	1

   (6) Change A5A1CR1 THRU CR3 to read: "A5A1CR2 AND CR3."
   (7) Change A5A1Q5 description to read: "TRANSISTOR SINGER PART NO. 99-556166-087."
   (8) Add A5A1Q5 manufacturer's part no. "2N2270."
   (9) Add A5A1Q5 mfr's code "81349."
   (10) Add maint qty "1."
   (11) Add:

A5A1R22	SAME AS A1A7R5

Addendum No. E27
(106-0133 01 to 02)
(106-0136 01 to 02)

ADDENDUM
FOR
MODEL NF-315

(Serial Nos. U14115 thru U14135 and U15427 and up)

I. PURPOSE.

This addendum is to correct existing errors in the instruction manual and to reflect latest equipment configuration.

II. ADDENDUM.

Incorporate the following changes into the instruction manual.

a. In table 1-7:

(1) Add

A1CR1 through A1CR4	CGD1460	Balanced modulator
A1CR5	CGD1460	Back-bias decoupling diode

(2) Delete

A1A8CR14	CGD1460	Back-bias diode

(3) Change diode type of A5A1CR1 from CGD1460 to 1N251.

(4) Change transistor type of A5A1Q5 and A5A1Q7 from 2N1306 to 2N2270.

b. Change paragraph 2-33.d. to read: "Note the meter indication on the RMS scale - it should read SET. If the meter indication is other than SET, adjust the RMS 0DB screwdriver control to obtain the proper indication of SET."

c. Change the last sentence of paragraph 3-8 to read: "The rms detector is calibrated by applying a 1-kHz reference voltage (when the WIDE BAND attenuator switch is set fully clockwise) and adjusting the RMS 0DB control to obtain a meter RMS scale indication of SET."

d. Change the last sentence of paragraph 3-15 to read: "Resistor A1R12, which is inserted ....."

e. Change the fourth sentence of paragraph 3-29 to read: "Balance is accomplished by means of RMS 0DB screwdriver control R5."

f. Change the fifth sentence of paragraph 3-29 to read: "..... to activate the 1-kHz calibration oscillator, potentiometer A2R15 is shunted across the calibration oscillator output providing a ....."

g. Change the fourth sentence of paragraph 3-30 to read: "..... to the emitter of A1A8Q4 through decoupling diode A1CR5."

h. In table 4-3:

(1) Change the seventh paragraph in the "Procedure" column of step 3 and the eighth paragraph in steps 6, 8, 10 and 12 to read: "Set the Detector function selector switch to RMS. Adjust the RMS 0DB screwdriver control, if necessary, to obtain a meter RMS scale indication of SET."

(2) Delete the eighth paragraph in the "Procedure" column of step 3 and the ninth paragraph in steps 6, 8, 10 and 12.

(3) Change the "Procedure" column of step 33 to read: "Connect a digital voltmeter between terminals D and F of the REMOTE INDICATOR connector. Rotate the FREQUENCY TUNING control throughout the band and note the voltmeter indication."

(4) Change the "Acceptable Indication" column of step 33 to read: "Analog x-output voltage varies linearly from 0 to +10 volts (±5%) with rotation of the FREQUENCY TUNING control."

i. Change the first sentence of paragraph 4-22.x. to read: "Set the Detector function selector switch to RMS and note the vtvm indication - the vtvm should indicate between 0.8 and 1.2 millivolts rms."

j. In table 4-16, change the nominal emitter and base voltages of Q1 to -0.75 and -0.7, respectively.

k. In table 6-1, add

81312	Winchester Electronics Division, Litton Industries Inc., Oakville, Conn.

106-0282-01 changed to -02
106-0133-00 changed to -02
106-0124-00 changed to -01
106-0137-00 changed to -02
106-0130-00 changed to -02
106-0136-00 changed to -04
106-0138-00 changed to -02

1. In table 6-2:
   (1) Add

BT1 AND BT2	BATTERY ASSY, 16V	103-0805-001	16665	2

(2) Change entry for F1 to read:

F1	FUSE, 1/4 AMP, DELAY SINGER PART NO. 556006-113	315.250	75915	5

(3) Change entry for J2 to read:

J2	CONNECTOR, BNC SINGER PART NO. 556010-158	UG-290A/U	81349	1

(4) Change entry for J3 to read:

J3	CONNECTOR, JACK, 5PIN, MALE SINGER PART NO. 556010-062	126-216	02660	1

(5) Change entry for J5 to read:

J5	CONNECTOR, FEMALE, 5 PIN SINGER PART NO. 556010-057	126-218	02660	1

(6) Change entry for P1 to read:

P1	CONNECTOR, 5 PIN, FEMALE, W/SHROUD PART OF W1 SINGER PART NO. 556016-105	126-223	02660	1

(7) Change entry of P2 to read:

P2	SAME AS J5

(8) Change entry for P3 and P4 to read:

P3	SAME AS P1

(9) Add

P4	NOT USED

(10) Change entry for P5 to read:

P5	CONNECTOR, PLUG, 20 PIN, W/HOOD SINGER PART NO. 556146-600	MRE-20S-G-H	81312	1

(11) Delete entry for S2

(12) Change A1CR1 THRU CR4 to read A1CR1 THRU CR5

(13) Add

A1C11 AND A1C12	CAPACITOR, ELECTROLYTIC, 100UF, 15V SINGER PART NO. 556146-334	TSD5-15-107	18641	1

(14) Change A1E1 THRU E19 to read A1E1 THRU E27

(15) Delete entry for A1A7R7

(16) Change A1A8CR9 THRU to read A1A8CR9 THRU CR12

(17) Delete entries for A1A8CR13 and A1A8CR14

(18) Change entry for A1A10C3 to read:

A1A10C3	SAME AS A1C11			

(19) Change entry for A5J1 to read:

A5J1	CONNECTOR, MALE, 20 PIN SINGER PART NO. 556146-599	MRE-20-P-G	81312	1

(20) Change entry for A5R1 to read:

A5R1	RESISTOR, VARIABLE, 5K OHMS, PORM 5 PCT	556056-075	16665	1

(21) Delete entry for A5R2

(22) Change entry for A5A1 to read:

A5A1	TUNABLE LOCAL OSCILLATOR, COMPONENT BOARD	103-1507-001	16665	1

(23) Change A5A1CR1 THRU CR3 to read:

A5A1CR1	SEMICONDUCTOR DEVICE, DIODE SINGER PART NO. 556118-046	1N251	81349	1

(24) Add

A5A1CR2 AND CR3	SAME AS A1CR1			

(25) Change A5A1C5 AND to read A5A1C5 and C6

(26) Add

A5A1C9 AND C10	SAME AS A1C11			

(27) Add

A5A1L1	SAME AS A1L5			

(28) Change entry for A5A1Q5 to read:

A5A1Q5	TRANSISTOR SINGER PART NO. 556116-087	2N2270	81349	1

(29) Change entry A5A1Q7 to read:

A5A1Q7	SAME AS A5A1Q5			

(30) Change A5A1R5 to read A5A1R5 and R6

(31) Delete entry for A5A1R6

(32) Add

A5A1R22	SAME AS A1A7R5			

(33) Add

A5A1R23 AND R24	SAME AS A1A8R3			

(34) Add

A5A1R25	RESISTOR, FIXED, COMP., 4.3K OHMS, PORM 5 PCT, 1/2 W SINGER PART NO. 151-1003-432J	EB4325	01121	1

(35) Change entry for A6A1R6 to read:

A6A1R6	RESISTOR, FIXED, WIREWOUND, 25 OHMS, PORM 5 PCT 5 W SINGER PART NO. 556043-099	5X25	14841	1

TABLE OF CONTENTS

Paragraph		Page
	SECTION I—INTRODUCTION	
1-1	Scope of Manual	1-1
1-4	Purpose of the Equipment	1-1
1-7	General Description	1-1
1-10	Accessories	1-1
1-12	Model LW-315 Loop Antenna	1-2
1-13	Model CA-315 Capacitive Antenna	1-2
1-14	Model CP-315 Clamp-on Probe	1-2
1-16	Model RE-315 Remote Indicator	1-4
1-17	Model EA-315 Earphones	1-4
1-18	Equipment Specifications	1-4
1-20	Assembly and Component Board Reference Symbol Numbers	1-4
1-22	Transistor, Diode, Fuse and Indicator Lamp Complement	1-4
	SECTION II—OPERATION	
2-1	General	2-1
2-3	Installation	2-1
2-4	Unpacking	2-1
2-5	External Inspection	2-1
2-6	Internal Inspection	2-1
2-7	Mounting - Cabinet Unit	2-1
2-9	Mounting - Rack Unit	2-1
2-11	Outline Drawings	2-1
2-12	General Measurement Information	2-1
2-14	Mode Selection	2-3
2-15	Detector Selection	2-3
2-16	Input Impedance Selection	2-3
2-17	Pickup Device Selection	2-3
2-22	Site Selection	2-3
2-25	Operation	2-3
2-27	Operating Controls, Indicators and Connectors	2-3
2-28	Starting Procedure - Ac Operation	2-6
2-30	Starting Procedure - Battery Operation	2-10
2-31	Preliminary Adjustments	2-10
2-32	Gain Calibration	2-10
2-33	Meter RMS Scale Calibration	2-11
2-34	Modulator Balancing	2-11
2-35	Two-terminal Voltmeter Measurements	2-11
2-40	Noise and Field Intensity Measurements	2-13
2-44	Calibration Curves and Antenna and Probe Factors	2-16
2-46	Stopping Procedure	2-17
2-47	Packaging Instructions	2-17
2-48	Short Term Storage	2-17
2-49	Long Term Storage or Shipment	2-17
	SECTION III—THEORY OF OPERATION	
3-1	General	3-1
3-3	Simplified Block Diagram Analysis	3-1
3-10	Detailed Theory of Operation, Input Section	3-2
3-11	Input Impedance Matching Network	3-2

TABLE OF CONTENTS (Cont'd)

Paragraph		Page
	SECTION III — THEORY OF OPERATION (Cont'd)	
3-12	Broadband Input Attenuator	3-2
3-13	1-kHz Calibration Oscillator	3-9
3-14	20-kHz Low-pass Filter	3-9
3-15	Broadband Low-noise Preamplifier	3-9
3-16	Detailed Theory of Operation, Wide Band Section	3-9
3-17	Wide Band Attenuator	3-9
3-18	Wide Band Amplifier	3-9
3-19	Detailed Theory of Operation, Narrow Band Section	3-10
3-20	Tunable Local Oscillator	3-10
3-21	Input Crystal Filter and Balanced Modulator	3-10
3-22	Narrow Band Attenuator	3-11
3-23	100-kHz I-f Amplifiers	3-11
3-24	I-f Crystal Filters	3-11
3-25	Detailed Theory of Operation, Output Section	3-11
3-26	Gain Equalization Network	3-11
3-27	Broadband Driver Amplifier	3-11
3-28	Average Detector	3-13
3-29	Rms Detector	3-13
3-30	Peak Detector	3-13
3-31	Log Amplifier	3-13
3-32	Audio and Beat Frequency Circuits	3-13
3-33	Detailed Theory of Operation, Power Supplies	3-13
	SECTION IV — MAINTENANCE	
4-1	General	4-1
4-3	Test Equipment Required	4-1
4-5	Minimum Performance Standards Checks	4-1
4-7	Component Locations	4-1
4-9	Power Supply Check	4-2
4-11	Localizing Trouble Within the Power Supply	4-39
4-13	Setting Power Supply Voltages	4-39
4-15	Battery Replacement	4-39
4-17	Systematic Trouble Localization Procedure	4-40
4-19	Troubleshooting and Calibration Procedures	4-69
4-21	20-kHz Low-pass Filter and Broadband Low-noise Preamplifier A1A10, Troubleshooting	4-69
4-22	Attenuator and 1-kHz calibration Oscillator A2, Troubleshooting	4-69
4-23	Wide Band Amplifier A1A11, Troubleshooting	4-71
4-24	Tunable Local Oscillator A5, Troubleshooting	4-71
4-25	Tunable Local Oscillator A5, Calibration	4-74
4-26	Input Crystal Filter A1A2, Troubleshooting	4-74
4-27	100-kHz I-f Amplifiers A1A4 and A1A6, Troubleshooting	4-75
4-28	100-kHz I-f Crystal Filters A1A3 and A1A5, Troubleshooting	4-76
4-29	Equalizing Gain Between 70-Hz and 7-Hz Tunable Narrow Band Modes	4-76
4-30	Input Impedance Gain Equalization	4-77
4-31	Broadband Driver Amplifier A1A9, Troubleshooting	4-78
4-32	Detector A1A8, Troubleshooting	4-79
4-33	Log Amplifier A1A7, Troubleshooting	4-79
4-34	Log Amplifier A1A7, Calibration (Meter AVG Scale Tracking)	4-80
4-35	Meter RMS and PEAK Scale Tracking	4-81
4-36	Obtaining New Calibration Curve	4-82
4-37	Audio Amplifier and BFO/Mixer A3A1, Troubleshooting	4-82
4-38	Audio Amplifier A3A2, Troubleshooting	4-82
4-39	Tracking Analog X Output Voltage	4-88

TABLE OF CONTENTS (Cont'd)

Paragraph — Page

SECTION V—SCHEMATIC DIAGRAMS

SECTION VI—PARTS LIST

6-1	Introduction	6-1
6-3	Ordering Information	6-1
6-5	How to Use the Parts List	6-1
6-7	Ref Symbol Column	6-1
6-8	Description Column	6-1
6-9	Manufacturer's Part Number Column	6-1
6-10	Mfr's Code Column	6-1
6-11	Maint Qty Column	6-1

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Model NF-315 Noise and Field Intensity Meter	vi
1-2	Optionally Available Accessories	1-2
2-1	Model NF-315 Outline Drawings	2-2
2-2	Typical Bandpass Characteristics	2-4
2-3	Operating Controls, Indicators and Connectors	2-7
2-4	Power Transformer Wiring Diagram	2-10
2-5	100, 000-Ohm Input Impedance Calibration Curves	2-18
2-6	600-Ohm Input Impedance Calibration Curves	2-19
2-7	50-Ohm Input Impedance Calibration Curves	2-20
2-8	Model CA-315 Capacitive Antenna, Antenna Factor Vs. Frequency Characteristic Curve	2-21
2-9	Model LW-315 Loop Antenna, Antenna Factor Vs. Frequency Characteristic Curve	2-21
2-10	Model CP-315 Clamp-on Probe, Transfer Admittance Vs. Frequency Characteristic Curve	2-22
2-11	Packaging Diagram	2-23
3-1	Model NF-315 Noise and Field Intensity Meter, Simplified Block Diagram	3-3
3-2	Model NF-315 Noise and Field Intensity Meter, Detailed Block Diagram	3-5
3-3	Power Distribution Diagram	3-15
4-1	Test Setup for Minimum Performance Standards Checks	4-4
4-2	Top View of Model NF-315 Showing Component Locations and Trouble Localization Procedure Test Points	4-37
4-3	Rear View of Model NF-315 Showing Component Locations	4-38
4-4	Bottom View of Model NF-315 Showing Component Locations and Trouble Localization Procedure Test Points	4-38
4-5	D-c Power Supply A7, Component Location Diagram	4-40
4-6	Detector Line Filter Component Board A1A1, Component Location Diagram	4-40
4-7	Voltage Regulator A6, Component Location Diagram	4-41
4-8	Detailed Block Diagram Showing Trouble Localization Procedure Test Points	4-47
4-9	Initial Test Setup for Trouble Localization Procedure	4-51
4-10	20-kHz Low-pass Filter and Broadband Low-noise Premaplifier Plug-in Component Board A1A10, Component Location Diagram	4-70
4-11	1-kHz Calibration Oscillator Component Board A2A1, Component Location Diagram	4-70
4-12	Wide Band Amplifier Plug-in Component Board A1A11, Component Location Diagram	4-72
4-13	Tunable Local Oscillator A5, Component Location Diagram	4-73
4-14	Tunable Local Oscillator Plug-in Component Board A5A1, Component Location Diagram	4-73

LIST OF ILLUSTRATIONS (Cont'd)

Figure		Page
4-15	Input Crystal Filter Plug-in Component Board A1A2, Component Location Diagram	4-75
4-16	100-kHz I-f Amplifier Plug-in Component Boards A1A4 and A1A6, Component Location Diagram	4-76
4-17	100-kHz I-f Crystal Filter Plug-in Component Boards A1A3 and A1A5, Component Location Diagram	4-77
4-18	Broadband Driver Amplifier Plug-in Component Board A1A9, Component Location Diagram	4-78
4-19	Detector Plug-in Component Board A1A8, Component Location Diagram	4-79
4-20	Log Amplifier Plug-in Component Board A1A7, Component Location Diagram	4-80
4-21	Audio Amplifier and BFO/Mixer Plug-in Component Board A3A1, Component Location Diagram	4-83
4-22	Audio Amplifier Plug-in Component Board A3A2, Component Location Diagram	4-83
5-1	Model NF-315 Noise and Field Intensity Meter, Interassembly Connection Diagram	5-3
5-2	20-kHz Low-pass Filter and Broadband Low-noise Preamplifier Plug-in Component Board A1A10, Schematic Diagram	5-7
5-3	Wide Band Amplifier Plug-in Component Board A1A11, Schematic Diagram	5-9
5-4	Input Crystal Filter Plug-in Component Board A1A2, Schematic Diagram	5-11
5-5	100-kHz I-f Amplifier Plug-in Component Boards A1A4 and A1A6, Schematic Diagram	5-13
5-6	100-kHz I-f Crystal Filter Plug-in Component Boards A1A3 and A1A5, Schematic Diagram	5-15
5-7	Broadband Driver Amplifier Plug-in Component Board A1A9, Schematic Diagram	5-17
5-8	Detector Plug-in Component Board A1A8, Schematic Diagram	5-19
5-9	Log Amplifier Plug-in Component Board A1A7, Schematic Diagram	5-21
5-10	Tunable Local Oscillator Plug-in Component Board A5A1, Schematic Diagram	5-23
5-11	1-kHz Calibration Oscillator Component Board A2A1, Schematic Diagram	5-25
5-12	Audio Amplifier and BFO/Mixer Plug-in Component Board A3A1, Schematic Diagram	5-27
5-13	Audio Amplifier Plug-in Component Board A3A2, Schematic Diagram	5-29
5-14	D-c Power Supply Component Board A7, Schematic Diagram	5-31
5-15	Voltage Regulator A6, Schematic Diagram	5-33
5-16	Detector Line Filter Component Board A1A1, Schematic Diagram	5-35
6-1	Parts List Sample	6-2

LIST OF TABLES

Table		Page
1-1	Model KT-315 Standard Accessory Kit Components	1-3
1-2	Optional Accessories	1-3
1-3	Model NF-315 Specifications	1-4
1-4	Sensitivity as a Two-terminal Voltmeter (Average Detection Function)	1-7
1-5	Measurement Accuracy as a Two-terminal Voltmeter	1-7
1-6	Model NF-315 Assemblies and Component Boards	1-7
1-7	Transistor and Diode Complement	1-8
1-8	Fuse and Indicator Lamp Complement	1-11
2-1	Operating Controls, Indicators and Connectors	2-6
2-2	Applicable Operating Procedures for Two-terminal Voltmeter Measurements	2-11
2-3	Applicable Operating Procedures for Noise and Field Intensity Measurements	2-14
2-4	Applicable Correction Factor as a Function of Selected Input Impedance and Bandwidth	2-16
2-5	Applicable Factor For Selected Pickup Device	2-17
3-1	Correlation between Input Attenuation, Wide Band Attenuation, Input Impedance and Wide Band dB Dial Indication (Meter dB Factor)	3-10
3-2	Correlation between Input Attenuation, Narrow Band Attenuation, Input Impedance, Wide Band dB Dial Indication and Narrow Band dB Dial Indication (Meter dB Factor)	3-12
4-1	Test Equipment Required	4-1
4-2	Preliminary Control Settings for Minimum Performance Standards Checks	4-2
4-3	Minimum Performance Standards Checks	4-3
4-4	Power Supply Check	4-39
4-5	Power Supply Trouble Localization Procedure	4-42
4-6	Systematic Trouble Localization Procedure	4-45
4-7	Voltage Measurements, Voltage Regulator A6	4-84
4-8	Voltage Measurements, Detector Line Filter A1A1	4-84
4-9	Voltage Measurements, 20-kHz Low-pass Filter and Broadband Low-noise Preamplifier A1A10	4-84
4-10	Voltage Measurements, 1-kHz Calibration Oscillator A2A1	4-85
4-11	Voltage Measurements, Wide Band Amplifier A1A11	4-85
4-12	Voltage Measurements, Tunable Local Oscillator A5A1	4-85
4-13	Voltage Measurements, Input Crystal Filter A1A2	4-86
4-14	Voltage Measurements, 100-kHz I-f Amplifiers A1A4 and A1A6	4-86
4-15	Voltage Measurements, 100-kHz I-f Crystal Filters A1A3 and A1A5	4-86
4-16	Voltage Measurements, Broadband Driver Amplifier A1A9	4-86
4-17	Voltage Measurements, Detector A1A8	4-87
4-18	Voltage Measurements, Log Amplifier A1A7	4-87
4-19	Voltage Measurements, Audio Amplifier and BFO/Mixer A3A1	4-88
4-20	Voltage Measurements, Audio Amplifier A3A2	4-88
6-1	Manufacturer's Code	6-2
6-2	Part List, Model NF-315	6-5
6-3	Parts List, Model KT-315	6-25
6-4	Parts List, Optional Accessories	6-26

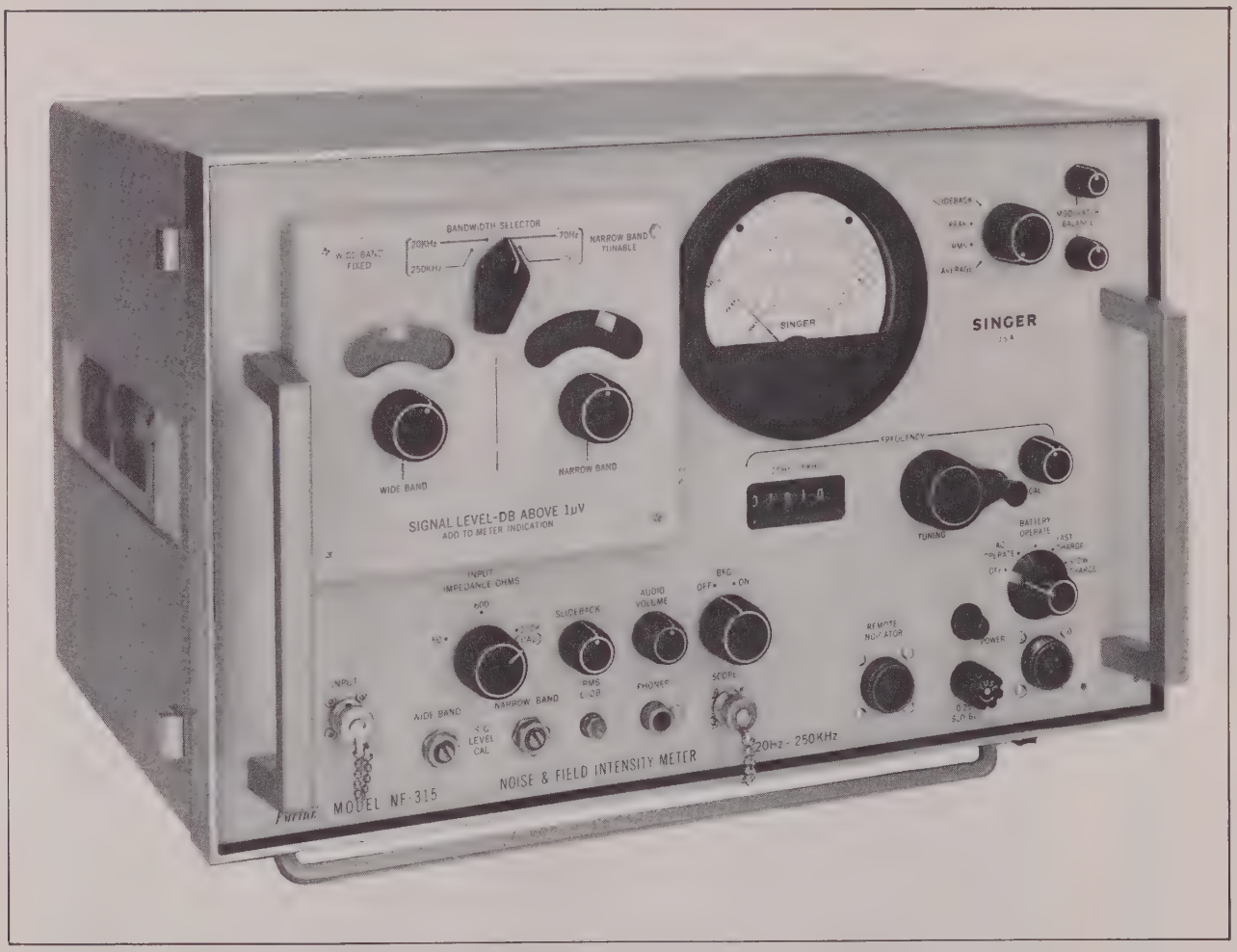


Figure 1-1. Model NF-315 Noise and Field Intensity Meter

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides operating and maintenance instructions for the EMPIRE* Model NF-315 Noise and Field Intensity Meter, manufactured by the Singer Company - Metrics Division, Bridgeport, Connecticut. Included in this manual are a general description of the Model NF-315 and available optional accessories, operating instructions, theory of operation, maintenance instructions and data, schematic diagrams and a repair parts list. The Model NF-315, less optional accessories, is illustrated in figure 1-1.

1-3. The information contained in this manual refers to the standard version of the Model NF-315 with available optional accessories, and is current only to the date of publication. Differences in equipment components, specifications and performance resulting from The Singer Company's continuous product improvement program or customer design and application requirements are described in addendum sheets.

1-4. PURPOSE OF THE EQUIPMENT.

1-5. The Model NF-315 is designed to measure the level and frequency of conducted, induced and radiated electromagnetic energy within the frequency range from 20 Hz to 15 kHz in accordance with standard commercial and military requirements. Some typical applications of the Model NF-315 are listed below:

a. Field intensity measurements;

b. Sensitive audio harmonic wave analyzer;

c. Sensitive tunable two-terminal voltmeter;

d. Sensitive wide band video receiver;

e. Highly selective and sensitive narrow band receiver;

f. Sensitive receiver for acoustic and vibration analysis;

g. Highly sensitive tunable null detector;

h. Determination of strain gage outputs;

i. Determination of shielding effectiveness;

j. Measurement of the radiation level from a system component or vehicle;

k. Measurement of the a-c current flowing in an r-f or power conductor.

1-6. Inquiries are invited regarding special applications of the Model NF-315 to particular requirements. Such inquiries should be directed to the attention of the Marketing Director.

1-7. GENERAL DESCRIPTION.

1-8. The Model NF-315 is a highly versatile noise and field intensity meter which combines both a tunable narrow band superheterodyne receiver and a complete wide band video receiver. The equipment can be used in either of two basic modes - tunable narrow band (measurement) mode or fixed tuned wide band (surveillance) mode - with two bandwidths provided for each mode. In the tunable narrow band mode of operation, the Model NF-315 covers the frequency range from 20 Hz to 15 kHz with a selectable 7 Hz or 70 Hz (nominal) bandwidth, thereby providing rapid measurement, precise signal identification and optimum sensitivity. In the fixed tuned wide band mode of operation, the Model NF-315 measures the composite strength of all signals within the frequency range from 20 Hz to 20 kHz or 20 Hz to 250 kHz, as selected by the operator.

1-9. Equipment circuitry is completely solid-state. Time-tested tuning techniques are employed to ensure reliable short and long term stability plus complete freedom from instabilities due to external effects. This inherent stability eliminates the need for equipment recalibration when tuning to a new frequency. Unitized design with the maximum use of modular plug-in printed-circuit cards makes the Model NF-315 both lightweight and compact. The equipment is ruggedly constructed for field use and contains integral rechargeable nickel-cadmium batteries and a charging circuit. R-f gasketing and filters permit operation of the Model NF-315 in areas of high ambient fields.

1-10. ACCESSORIES.

1-11. Unless otherwise specified, the equipment supplied consists of the Model NF-315 Noise and Field Intensity Meter and an a-c line cord. A Model

*Trademark of THE SINGER COMPANY

KT-315 Standard Accessory Kit (see figure 1-2 and table 1-1) and other optional accessories (see figure 1-2 and table 1-2) are available for use with the equipment. Paragraphs 1-12 through 1-17 contain a brief description of the major optional accessories.

1-12. MODEL LW-315 LOOP ANTENNA. The loop antenna, consisting of a multi-turn loop contained in an electrically shielded enclosure, is employed to evaluate radiated field intensity. Electrical shielding of the loop makes the antenna insensitive to electric fields. Either the 6-foot (Model CB-6-315) or 30-foot (Model CB-30-315) cable may be employed to couple the loop antenna to the Model NF-315. For best sensitivity, the 50-ohm input impedance of the Model NF-315 should be employed when working with the loop antenna, although broadband measurements can be made (with a corresponding reduction in sensitivity) using the 100,000-ohm input impedance of the equipment.

1-13. MODEL CA-315 CAPACITIVE ANTENNA. The capacitive antenna, which consists of a short rod-type antenna feeding an integral high-gain battery powered amplifier of high input impedance and low input capacity, is employed to evaluate radiated field intensity. Operating life of the capacitive antenna battery is approximately eight hours. Since the capacitive antenna is an active device, it is subject to overload in the presence of strong electric fields (refer to paragraph 2-41). Either the 6-foot (Model CB-6-315) or 30-foot (Model CB-30-315) cable may be employed to couple the capacitive antenna to the Model NF-315. For best sensitivity, the 50-ohm input impedance of the Model NF-315 should be employed when working with the capacitive antenna, although broadband measurements can be made (with a corresponding reduction in sensitivity) using the 100,000-ohm input impedance of the equipment.

1-14. MODEL CP-315 CLAMP-ON PROBE. The clamp-on probe, which consists of a split-core inserted primary r-f transformer, is employed to measure magnetic fields generated by currents flowing in conductors and cables up to 1-1/4 inches in

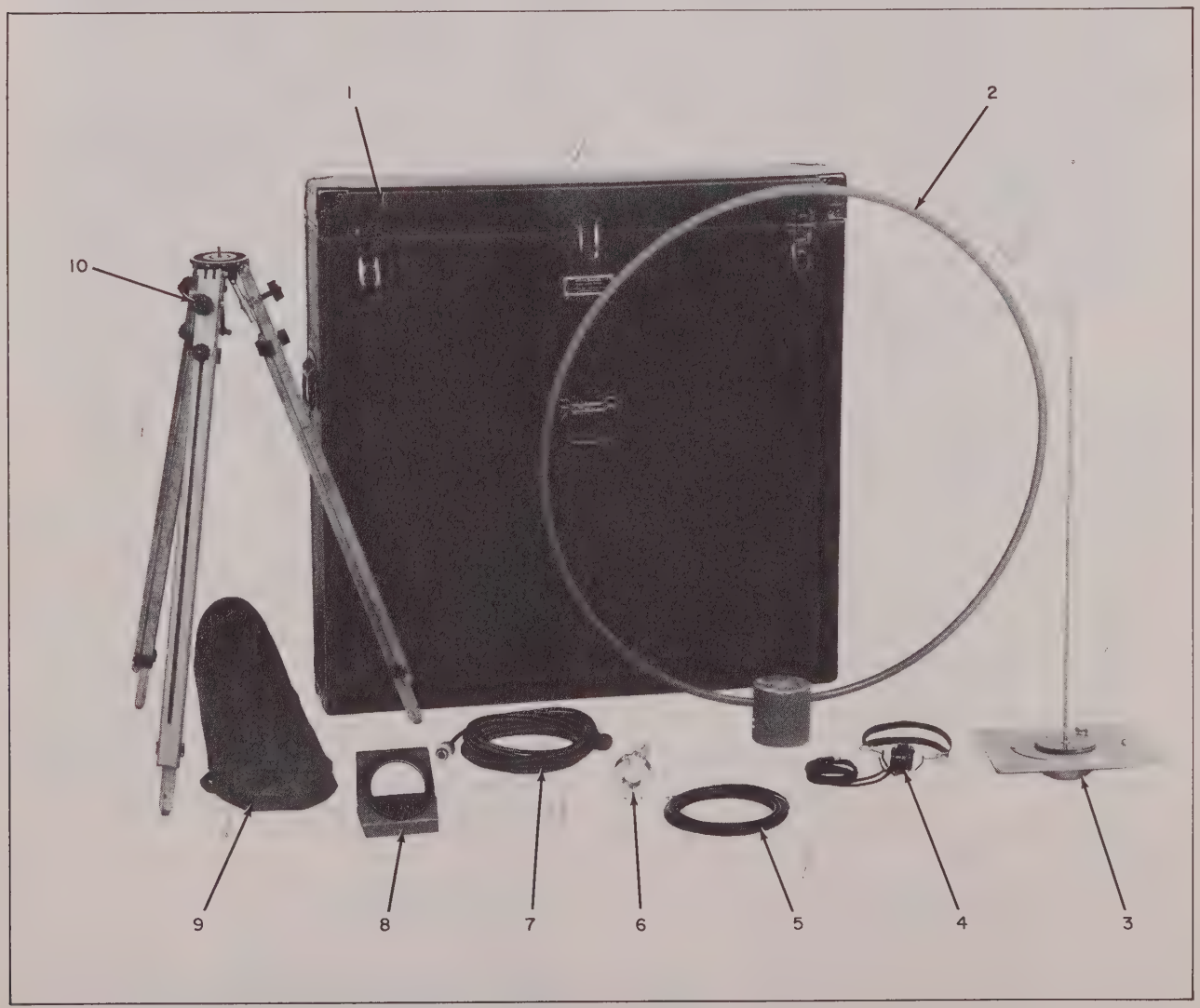


Figure 1-2. Optionally Available Accessories

TABLE 1-1. MODEL KT-315 STANDARD ACCESSORY KIT COMPONENTS

Figure 1-2 Index Number	Nomenclature	Function
1	Model AC-315 Accessory Carrying Case	Transit and storage case for Model KT-315 Standard Accessory Kit components
2	Model LW-315 Loop Antenna	Antenna employed to make radiated field measurements
Not shown	Model CB-30-315 Antenna Cable	Thirty foot cable which couples antenna or probe to Model NF-315
4	Model EA-315 Earphones	600-ohm headset used for aural monitoring and when making metered slideback measurements
5	Model CB-6-315 Antenna Cable	Six foot cable which couples antenna or probe to Model NF-315
9	Model BG-315 Tripod Carrying Case	Transit and storage case for Model TP-315-A Tripod
10	Model TP-315-A Tripod	Mount for either loop or capacitive antenna

TABLE 1-2. OPTIONAL ACCESSORIES

Figure 1-2 Index Number	Nomenclature	Function
3	Model CA-315 Capacitive Antenna	Antenna employed when making radiated field measurements
Not shown	Model AB-315 Adapter Brackets	Permits mounting of Model NF-315 in standard 19-inch equipment rack
6	Model CP-315 Clamp-on Probe	Probe employed when making conducted interference measurements on r-f and power cables
7	Model RC-315 Remote Indicator Cable	Twenty-five foot cable which couples Model RE-315 Remote Indicator to Model NF-315
8	Model RE-315 Remote Indicator	Permits remote readout of Model NF-315 meter indication

diameter without breaking the leads. Large conductor currents and voltages have no deleterious effects on measurement accuracy. The clamp-on feature of the probe provides the following advantages:

a. Permits the measurement of r-f interference in a high current circuit which would be impractical to break;

b. Permits the measurement of r-f interference in a complete harness assembly without taking individual measurements for each lead;

c. Permits the measurement of the interference field surrounding a shielded cable assembly.

1-15. Either the 6-foot (Model CB-6-315) or 30-foot (Model CB-30-315) cable may be employed to couple the clamp-on probe to the Model NF-315. The 50-ohm input impedance of the Model NF-315 must be used when making measurements with the clamp-on probe.

1-16. MODEL RE-315 REMOTE INDICATOR. The remote indicator, which is an exact duplicate of the Model NF-315 front panel meter, permits monitoring of applied signals at distances up to twenty-five feet from the equipment. The Model RC-315 Remote Indicator Cable is employed to couple the remote indicator to the Model NF-315.

1-17. MODEL EA-315 EARPHONES. The 600-ohm earphones are employed for aural monitoring of applied signals and when using the metered slideback technique to evaluate the peak level of applied signals.

1-18. EQUIPMENT SPECIFICATIONS.

1-19. The specifications of the Model NF-315 are listed in table 1-3.

1-20. ASSEMBLY AND COMPONENT BOARD REFERENCE SYMBOL NUMBERS.

1-21. Table 1-6 lists the reference symbol numbers of the assemblies and component boards that are contained within the Model NF-315.

1-22. TRANSISTOR, DIODE, FUSE AND INDICATOR LAMP COMPLEMENT.

1-23. Table 1-7 lists the type and function of the entire complement of transistors and diodes employed in the Model NF-315. The type and function of the fuses and indicator lamps employed in the equipment is contained in table 1-8.

TABLE 1-3. MODEL NF-315 SPECIFICATIONS

Parameter	Specification
TUNABLE NARROW BAND (MEASUREMENT) MODE	
Frequency range	20 Hz to 15 kHz in one continuous band
Frequency indicator	Digital readout, 0 to 15,000 Hz (last digit fixed)
Frequency indicator accuracy	±(1% + 5 Hz)
Intermediate frequency	100 kHz
I-f bandwidths	7 and 70 Hz (nominal), selectable
7 Hz	Between 5 and 8 Hz @ 3 dB 100 Hz (maximum) @ 70 dB
70 Hz	Between 50 and 80 Hz @ 3 dB 800 Hz (maximum) @ 70 dB
Dynamic range	Dependent upon detector function selected
Average detector function	180 dB (140 dB attenuation plus 40 dB meter scale), less internal noise level
Peak detector function	170 dB (140 dB attenuation plus 30 dB meter scale), less internal noise level

(Cont'd)

TABLE 1-3. MODEL NF-315 SPECIFICATIONS (Cont'd)

Parameter	Specification
TUNABLE NARROW BAND (MEASUREMENT) MODE (Cont'd)	
Dynamic range (Cont'd)	
Rms detector function	160 dB (140 dB attenuation plus 20 dB meter scale), less internal noise level
I-f and image rejection	Greater than 80 dB
Spurious response rejection	Greater than 70 dB
Beat frequency oscillator (BFO)	Crystal controlled; produces 600-Hz beat frequency tone
Analog X output	0 to 10 volts dc (±5%), as a function of frequency, into a minimum of 100,000 ohms
FIXED WIDE BAND (SURVEILLANCE) MODE	
Frequency range	Dependent upon input impedance selected
100,000-ohm input impedance	20 Hz to 20 kHz and 20 Hz to 250 kHz
50- and 600-ohm input impedance	20 Hz to 20 kHz
Dynamic range	Dependent upon detector function selected
Average detector function	140 dB (100 dB attenuation plus 40 dB meter scale), less internal noise level
Peak detector function	130 dB (100 dB attenuation plus 30 dB meter scale), less internal noise level
Rms detector function	120 dB (100 dB attenuation plus 20 dB meter scale), less internal noise level
TUNABLE NARROW BAND (MEASUREMENT) MODE AND FIXED WIDE BAND (SURVEILLANCE) MODE	
Input impedance*	100,000 ohms (nominal) unbalanced shunted by less than 60 pf, 600 ohms (nominal) unbalanced and 50 ohms (nominal) unbalanced, selectable
Detector functions	Average, true rms, direct peak and metered slideback, selectable
Maximum input voltage as a two-terminal voltmeter	Dependent upon input impedance and detector function selected
50- and 600-ohm input impedance:	
Average detector function	1 volt average
Peak detector function	1 volt peak
Rms detector function	0.1 volt rms
100,000-ohm input impedance:	
Average detector function	10 volts average
Peak detector function	10 volts peak
Rms detector function	1 volt rms

*Calibration curves supplied in SECTION II - Operation. (Refer to paragraph 2-44.)

(Cont'd)

TABLE 1-3. MODEL NF-315 SPECIFICATIONS (Cont'd)

Parameter	Specification
TUNABLE NARROW BAND (MEASUREMENT) MODE AND FIXED WIDE BAND (SURVEILLANCE) MODE (Cont'd)	
Sensitivity as a two-terminal voltmeter	See table 1-4
Measurement accuracy as a two-terminal voltmeter	See table 1-5
Meter	4-1/2-inch movement with linearly calibrated dB scales and logarithmically calibrated microvolt scales
Average scale	0 to 40 dB (1 to 100 microvolts)
Peak scale	10 to 40 dB (3.16 to 100 microvolts)
Rms scale	0 to 20 dB (1 to 10 microvolts)
Calibration oscillator	Amplitude stabilized; 1 kHz (nominal)
Signal overload protection	Normal operating procedure automatically prevents signal overload by initial insertion of low-pass filter and input attenuation prior to first active stage
Auxiliary outputs	Audio, remote indicator or recorder output and oscilloscope output
Audio output	100 milliwatts (nominal) into 600 ohms
Remote indicator or floating y-input of x-y recorder	0 to 1 milliampere dc into a maximum of 1500 ohms
Oscilloscope output	0.5 volts rms for full-scale meter indication. I-f signal displayed in tunable narrow band mode. Video signal displayed in fixed wide band mode. (True representation of applied signal provided when using rms and peak detector functions; compressed representation of applied signal provided when using average detector function.)
Operating power requirements	105 to 125 volts rms or 210 to 230 volts rms, 50 to 400 Hz, 20 watts
Operating temperature range	0 to +40°C (32 to 104°F)
Internal battery operation	Eight hours minimum continuous operation from full charged condition
Battery charging	Trickle charge automatically applied during normal operation from a-c line; fast charging rate (approximately 14 hours) or slow charging rate (approximately 30 hours) when equipment is not in use but coupled to a-c line

TABLE 1-4. SENSITIVITY AS A TWO-TERMINAL VOLTMETER (AVERAGE DETECTOR FUNCTION)

Input Impedance	Sensitivity* @ 2 KHZ			
	7 HZ TUNABLE NARROW BAND MODE	70 HZ TUNABLE NARROW BAND MODE	20 KHZ FIXED WIDE BAND MODE	250 KHZ FIXED WIDE BAND MODE
50 OHMS	0.005 microvolts	0.015 microvolts	0.4 microvolts	- - - - - - - - -
600 OHMS	0.015 microvolts	0.047 microvolts	1.0 microvolts	- - - - - - - - -
100,000 OHMS	0.15 microvolts	0.47 microvolts	10 microvolts	13 microvolts

* Based on signal level required for 3 dB rise of meter indication

Note: Below 2 khz, the sensitivity is reciprocally reduced due to 1/f noise by a maximum of 20 dB at 20 Hz.

TABLE 1-5. MEASUREMENT ACCURACY AS A TWO-TERMINAL VOLTMETER

Input Impedance	Bandwidth	Measurement Accuracy		
		Average Detector Function	Rms Detector Function	Peak Detector Function
100,000 Ohms	7 and 70 Hz	±1.0 dB	±1.0 dB	±1.0 dB
	20 kHz	±1.1 dB	±1.3 dB	±1.5 dB
	250 kHz	±1.1 dB	±1.5 dB	±1.5 dB
600 Ohms	7 and 70 Hz	±1.0 dB	±1.2 dB	±1.2 dB
	20 kHz	±1.2 dB	±1.4 dB	±1.6 dB
50 Ohms	7 and 70 Hz	±1.3 dB	±1.5 dB	±1.4 dB
	20 kHz	±1.3 dB	±1.5 dB	±1.4 dB

The above accuracies apply under the following conditions:

1. Meter indication is corrected by factor supplied in calibration curves (refer to paragraph 2-44).
2. Meter indication is 30 DB on AVG scale, 34 DB on PEAK scale or 10 DB on RMS scale. At other than these indications the tracking accuracy of ±0.5 dB/10 dB from above reference indications must also be included.

TABLE 1-6. MODEL NF-315 ASSEMBLIES AND COMPONENT BOARDS

Assembly and/or Component Board	Description
A1	I-f Shelf Assembly
A1A1	Detector Line Filter Component Board
A1A2	Input Crystal Filter Plug-in Component Board

(Cont'd)

TABLE 1-6 MODEL NF-315 ASSEMBLIES AND COMPONENT BOARDS (Cont'd)

Assembly and/or Component Board	Description
A1A3	I-f Crystal Filter Plug-in Component Board
A1A4	I-f Amplifier Plug-in Component Board
A1A5	I-f Crystal Filter Plug-in Component Board
A1A6	I-f Amplifier Plug-in Component Board
A1A7	Log Amplifier Plug-in Component Board
A1A8	Detector Plug-in Component Board
A1A9	Broadband Driver Amplifier Plug-in Component Board
A1A10	20-KHz Low-pass Filter and Broadband Low-noise Preamplifier Plug-in Component Board
A1A11	Wide Band Amplifier Plug-in Component Board
A2	Attenuator and Calibration Oscillator Assembly
A2A1	Calibration Oscillator Plug-in Component Board
A3	Beat Frequency Oscillator and Audio Amplifier Assembly
A3A1	Audio Amplifier and BFO/Mixer Plug-in Component Board
A3A2	Audio Amplifier Plug-in Component Board
A4	Input Impedance Selector Assembly
A5	Tunable Local Oscillator Assembly
A5A1	Tunable Local Oscillator Plug-in Component Board
A6	Voltage Regulator Assembly
A6A1	Voltage Regulator Component Board
A7	D-c Power Supply Component Board

TABLE 1-7. TRANSISTOR AND DIODE COMPLEMENT

Reference Symbol Number	Transistor Or Diode Type	Function
A1A1Q1	2N1302	Series regulator
A1A1Q2	2N404	Series regulator
A1A2Q1	A307	Emitter follower
A1A2Q2	A1380	Emitter follower
A1A2Q3 and A1A2Q4	2N404	Emitter followers
A1A3Q1 and A1A3Q2	2N404	Emitter followers
A1A4Q1	2N2188	Emitter follower
A1A4Q2 and A1A4Q3	2N2188	I-f amplifiers

(Cont'd)

TABLE 1-7. TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor Or Diode Type	Function
A1A4Q4	2N2188	I-f output amplifier
A1A5Q1 and A1A5Q2	2N404	Emitter followers
A1A6Q1	2N2188	Emitter follower
A1A6Q2 and A1A6Q3	2N2188	I-f amplifiers
A1A6Q4	2N2188	I-f output amplifier
A1A7CR1	132-0180-001	Logarithmic element
A1A7CR2	1N762	Voltage regulator
A1A7CR3 thru A1A7CR5	1N270	Compensating diodes
A1A7CR6	1N270	Bias diode
A1A7Q1 and A1A7Q2	A1380	Differential amplifier
A1A7Q3 and A1A7Q4	2N1303	Difference amplifier
A1A7Q5	2N404	Emitter follower
A1A7Q6	2N1306	Meter drive amplifier
A1A8CR1 thru A1A8CR8	HU50	Rms bridge detector
A1A8CR9 thru A1A8CR12	CGD1460	Average bridge detector
A1A8CR14	CGD1460	Back-bias diode
A1A8Q1	SM8553	Differential amplifier
A1A8Q2 and A1A8Q3	2N3638	Difference amplifier
A1A8Q4	2N1302	Peak detector
A1A9CR1	CGD1460	Gain adjust diode
A1A9CR2 thru A1A9CR5	CGD1460	Average feedback bridge
A1A9Q1	A1380	Emitter follower
A1A9Q2	2N2188	Amplifier
A1A9Q3 and A1A9Q4	2N1302	Amplifiers

(Cont'd)

TABLE 1-7. TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor Or Diode Type	Function
A1A9Q5 and A1A9Q6	2N404	Difference amplifier
A1A9Q7	2N404	Emitter follower
A1A9Q8	2N1306	Output amplifier
A1A9Q9	2N404	Output amplifier
A1A10CR1	1N762	Voltage reference
A1A10Q1	2N2386	Amplifier
A1A10Q2 and A1A10Q3	A307	Amplifiers
A1A10Q4	2N404	Output amplifier
A1A10Q5	2N1306	Output amplifier
A1A11CR1	1N270	Gain adjust diode
A1A11Q1	2N2188	Emitter follower
A1A11Q2	2N2188	Amplifier
A1A11Q3	2N1302	Amplifier
A1A11Q4	2N404	Emitter follower
A1A11Q5	2N404	Emitter follower
A1CR1 thru A1CR4	CGD1460	Balanced bridge modulator
A2A1CR1	1N726	Voltage regulator
A2A1Q1	2N404	Calibration oscillator
A3A1Q1	2N2188	Beat frequency oscillator
A3A1Q2	2N2188	Bfo mixer and audio amplifier
A3A2CR1	CGD1460	Audio detector
A3A2Q1	2N404	Audio amplifier
A3A2Q2	SM4645	Audio output amplifier
A3A2Q3	2N696	Audio output amplifier
A5A1CR1	CGD1460	Biasing diode
A5A1CR2	CGD1460	Amplitude stabilizer
A5A1CR3	CGD1460	Rectifier
A5A1Q1	2N2188	Oscillator

(Cont'd)

TABLE 1-7. TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor Or Diode Type	Function
A5A1Q2	2N1302	Buffer amplifier
A5A1Q3	2N404	Amplifier
A5A1Q4	2N1302	Amplifier
A5A1Q5 and A5A1Q7	2N1306	Output amplifier
A5A1Q6	2N404	Automatic amplitude control
A6A1CR1	1N751	Voltage reference
A6A1CR2	1N762	Voltage reference
A6A1CR3	1N751	Voltage reference
A6A1CR4	1N762	Voltage reference
A6A1Q1	2N404	Emitter follower
A6A1Q2	2N404	Control amplifier
A6A1Q3	2N1302	Emitter follower
A6A1Q4	2N1302	Control amplifier
A6CR1 and A6CR2	1N1596	Voltage regulator
A6CR5 and A6CR6	1N270	Blocking diodes
A6Q1 thru A6Q3	2N242	Series regulators
A6Q4	2N1483	Series regulator
A7CR1 thru A7CR4	CER500	Full wave rectifiers

TABLE 1-8. FUSE AND INDICATOR LAMP COMPLEMENT

Reference Symbol Number	Type	Function
	FUSES	
A6F1 and A6F2	3/8 Amp, delay	Voltage regulator protective fuses
F1	1/4 Amp. delay	Line protective fuse
	LAMPS	
DS1	NE-2J	POWER indicator lamp

SECTION II

OPERATION

2-1. GENERAL.

2-2. This section contains instructions for the installation and operation of the Model NF-315. It is recommended that the operator become thoroughly familiar with the material in this section before attempting to operate the equipment. Failure to do so may compromise the great versatility and accuracy that has been engineered into the Model NF-315.

2-3. INSTALLATION.

2-4. UNPACKING. The unpacking and handling of the Model NF-315 requires that the normal precautions applicable to the handling of sensitive electronic equipment be employed. Check the contents of all shipping containers against the packing list to ensure that the shipment is complete.

2-5. EXTERNAL INSPECTION. After the Model NF-315 has been removed from its shipping container, undo the four latches that secure the dust cover to the front panel of the equipment. (Note that the latches and dust cover are part of the cabinet unit version of the Model NF-315 and are not provided on the rack-mounted version of the unit.) Remove the cover and visually inspect the equipment for indications of damage which may have occurred during shipment. Check front panel controls for freedom of movement, full travel and positive detent locking. Note any evidence, such as broken glass, dents, etc., indicating that the equipment has sustained a severe shock. Check the condition of all accessories supplied with the Model NF-315.

2-6. INTERNAL INSPECTION. Remove the four rear panel retaining screws and withdraw the Model NF-315 from its case. Remove the top (i-f shelf) cover plate and the two bottom cover plates. Check that all transistors, crystals, cables and plug-in printed-circuit cards are properly installed. Replace the three cover plates and install the equipment into its case.

2-7. MOUNTING - CABINET UNIT. The cabinet unit version of the Model NF-315 should be mounted on a sturdy surface that is free from vibration. A tilt bar is affixed to the underside of the case to lift the front of the Model NF-315 to facilitate front panel viewing. To use the tilt bar, lift the front of the NF-315 and swing the tilt bar down and fully forward. Holding the tilt bar in this position, carefully lower the front of the equipment.

2-8. The cabinet unit version of the Model NF-315 is provided with a removable rubber-gasketed front panel dust cover designed to protect the equipment from dust, dirt and moisture during storage, transit and other non-operating periods. This protective dust cover should be secured over the equipment front panel whenever the Model NF-315 is not in use.

2-9. MOUNTING - RACK UNIT. The rack-mounted version of the Model NF-315 is identical to the cabinet unit version with the following two exceptions: no front panel dust cover is supplied and two Model AB-315 Adapter Brackets are secured to the case. (To retrofit a cabinet unit for rack mounting, remove the front panel dust cover and then withdraw the equipment from its case. Remove the four latch hooks from the case and secure the adapter brackets in their place, using the original latch hook mounting hardware. Replace the equipment into the case.) Note that the front panel dust cover cannot be secured to the rack-mounted version of the NF-315.

2-10. Installation of the equipment into a standard 19-inch rack is best accomplished with two men. Insert the unit into the rack so that the adapter bracket slots are directly in front of the rack mounting rails. Adjust the height of the Model NF-315 as desired and fasten the equipment to the rack, starting with the lowest adapter bracket mounting holes. If other equipment is to be installed beneath the Model NF-315, the tilt bar on the underside of the case should be secured in the retracted position.

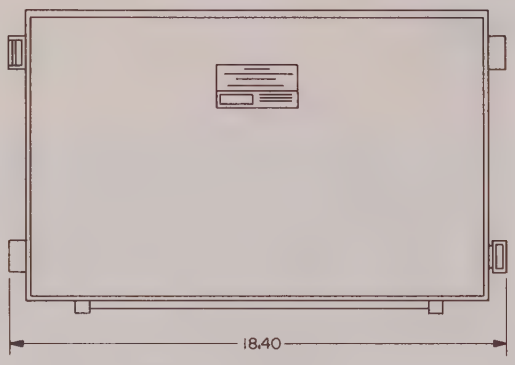
2-11. OUTLINE DRAWINGS. The outline drawings of both the cabinet unit and rack-mounted versions of the Model NF-315 are shown in figure 2-1. All dimensions shown are in inches.

2-12. GENERAL MEASUREMENT INFORMATION.

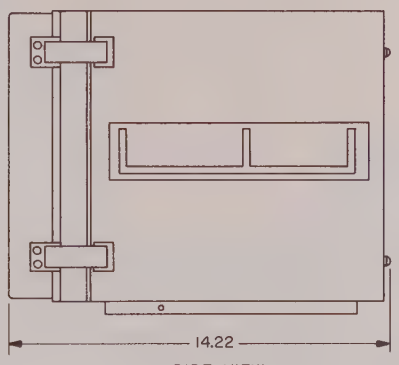
2-13. The Model NF-315 is essentially an extremely sensitive two-terminal voltmeter which, in conjunction with accessory pickup devices, serves as a low-frequency noise and field intensity meter. Because of the many combinations of input impedance, bandwidths and detector functions available for signal measurement, it is impractical to provide detailed measurement procedures for each possibility. The general information discussed in paragraphs 2-14 through 2-20 will supply the operator with sufficient data to select the proper operating mode for use in such typical applications listed below:

a. Field intensity measurements;

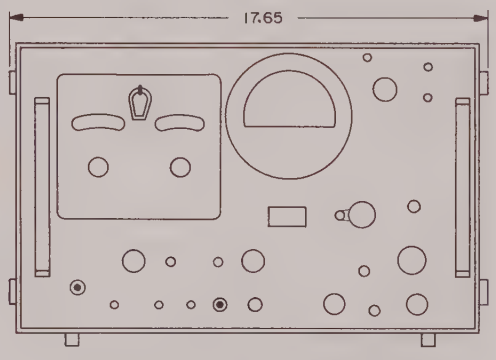
b. Audio harmonic wave analysis;



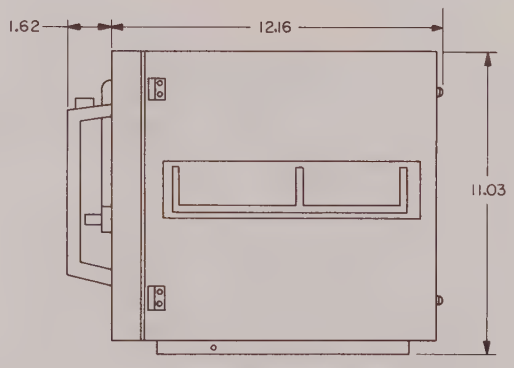
FRONT VIEW WITH DUST COVER



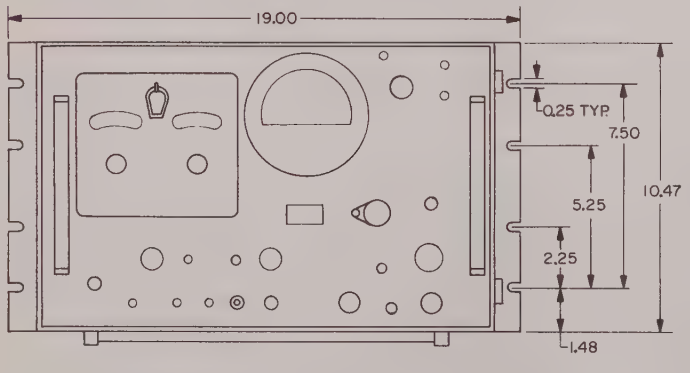
SIDE VIEW



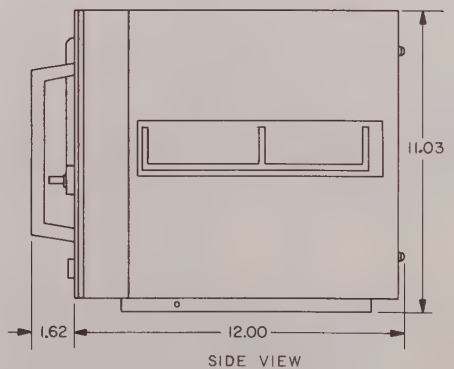
FRONT VIEW WITH DUST COVER REMOVED



SIDE VIEW



FRONT VIEW OF RACK-MOUNTED VERSION



SIDE VIEW

Figure 2-1. Model NF-315 Outline Drawings

c. Tunable two-terminal voltmeter;

d. Wide band video receiver;

e. Frequency-selective sensitive narrow band receiver;

f. Acoustic and vibration analysis;

g. Tunable null detector;

h. Measuring strain gage outputs;

i. Evaluation of shielding effectiveness;

j. Measurement of component and system radiation levels;

k. Measuring electromagnetic field surrounding conductors and cables.

2-14. MODE SELECTION. The Model NF-315 provides two basic modes of operation; fixed wide band (untuned) and tunable narrow band (frequency selective). In the fixed wide band mode of operation, the composite signal level in the frequency spectrum from 20 Hz to 20 kHz or from 20 Hz to 250 kHz (see figures 2-2a and 2-2b, respectively) can be measured to insure that the input section is not overloaded by strong in-band signals. In the tunable narrow band mode the signal content of any 7 or 70 Hz wide segment within the frequency range from 20 Hz to 14 kHz (see figure 2-2c and 2-2d, respectively) can be measured.

2-15. DETECTOR SELECTION. The selectable detector functions of the Model NF-315 permit the operator to determine the average, rms and peak values of applied signals directly. The metered slideback detector function enables the operator to evaluate the peak value of an individual signal in the presence of multiple signals.

2-16. INPUT IMPEDANCE SELECTION. The selectable 50-, 600- and 100,000-ohm input impedances of the Model NF-315 matches the equipment to commonly used characteristic impedances. The 100,000-ohm input impedance permits the measurement of open-circuit voltages since it minimizes output loading.

2-17. PICKUP DEVICE SELECTION. The pickup devices employed with the Model NF-315 transforms the equipment from a two-terminal voltmeter to a sensitive Noise and Field Intensity Meter.

2-18. The Model LW-315 Loop Antenna is employed when measuring radiated fields. The shielding surrounding the loop antenna renders it insensitive to electric fields.

2-19. The Model CA-315 Capacitive Antenna is a high-impedance active device which is employed to measure radiated fields. Care should be exercised when using the capacitive antenna (refer to paragraph 2-41) as it is subject to overload in the presence of strong electric fields.

2-20. The Model CP-315 Clamp-on Probe is employed to measure the current flowing in cables or groups of conductors. Care should be exercised when using the probe to prevent it from touching shield braids, ground planes and metal parts, thereby eliminating ground loops.

2-21. Note that the loop antenna, capacitive antenna and clamp-on probe provide the most accurate indications when used in conjunction with the recommended 50-ohm input impedance of the Model NF-315. The loop antenna and the capacitive antenna can also be used in conjunction with the 100,000-ohm input impedance with a corresponding sacrifice in sensitivity.

2-22. SITE SELECTION. Site requirements are determined by the type of measurement to be performed and standard practices.

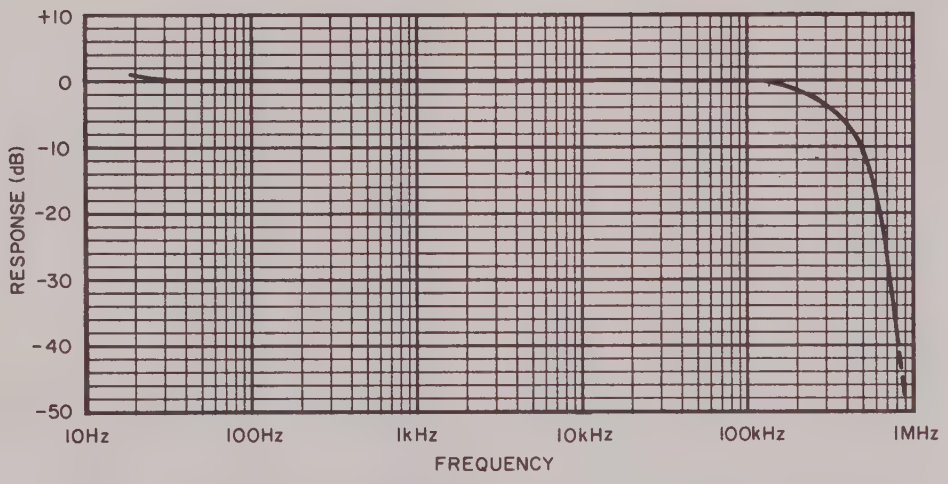
2-23. Indoor interference and field intensity measurements should be made in a shielded room so that stray signals not associated with the test sample will not affect the measurement accuracy. The ground plane should be bonded to the screen room walls to improve measurement accuracy. Personnel present should be limited to the minimum number required for the actual measurement, and no one should be less than 3 feet from either the test sample or the pickup device.

2-24. Outdoor interference and field intensity measurements should be made on an open, level site, preferably at the top of a hill or over water. While atmospheric noise is inevitably present, other ambient noises should be eliminated or minimized as much as possible. It should be noted that reception over water is normally more noise-free than over land. The selected site should have a minimum of trees and underbrush and be at least 100 feet from any possible source of man-made interference such as power lines, telephone lines, industrial buildings, etc. Undesirable results can be expected if the measurements are conducted in the proximity of steel bridges, overpasses, underpasses, metal fences, steel-framed buildings and any other object displaying conductive or inductive properties.

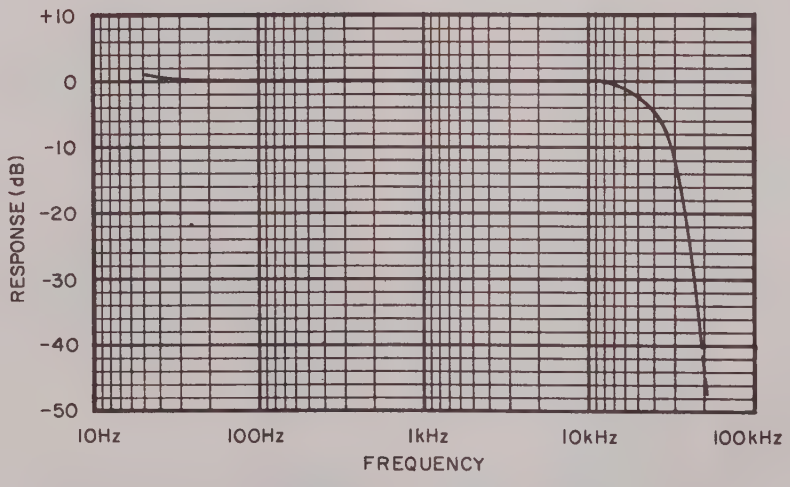
2-25. OPERATION.

2-26. The procedures for proper operation of the Model NF-315 are contained in paragraphs 2-27 through 2-46.

2-27. OPERATING CONTROLS, INDICATORS AND CONNECTORS. All controls, indicators and connectors necessary for operation of the Model NF-315 are located on the equipment front panel,

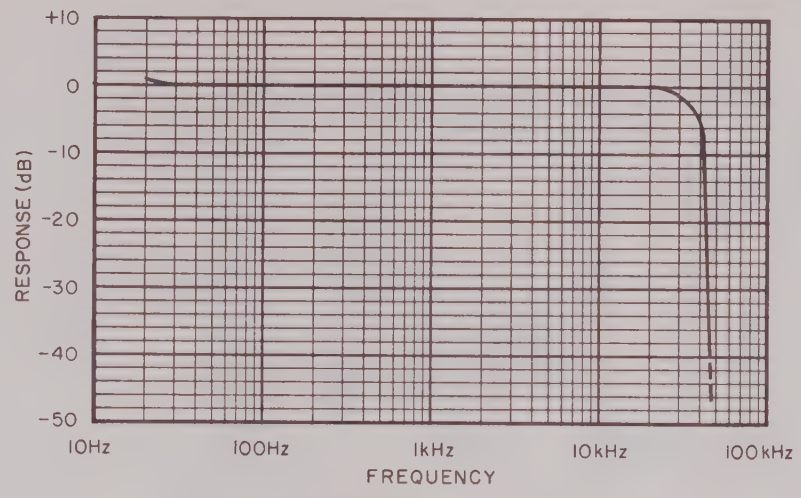


A. 250KHZ FIXED WIDE BAND MODE - 100,000-OHM INPUT IMPEDANCE

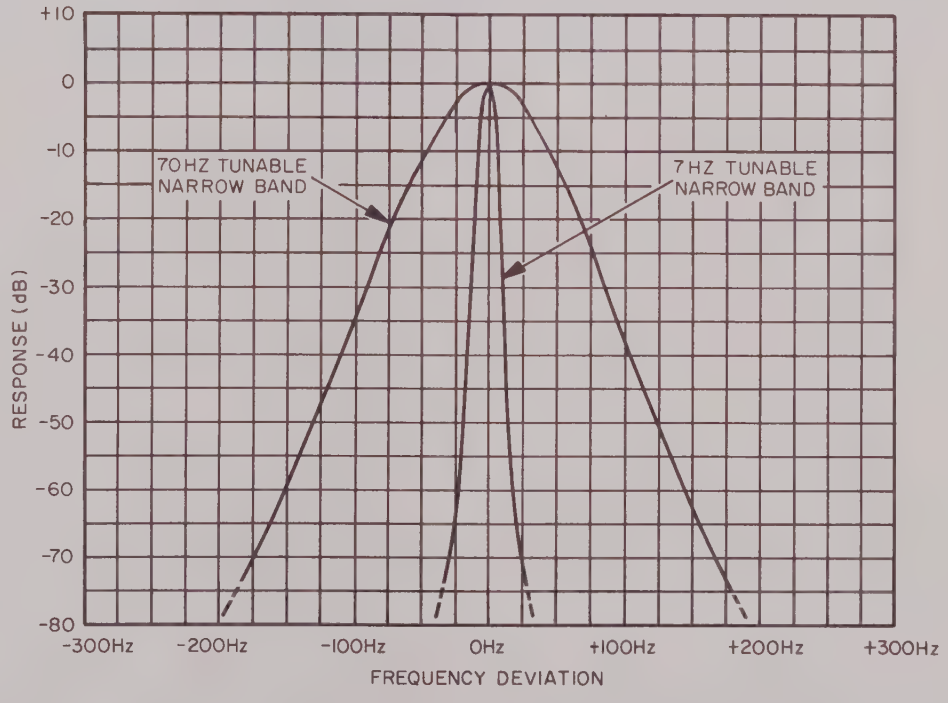


B. 20KHZ FIXED WIDE BAND MODE - 100,000 OHM INPUT INPEDANCE

Figure 2-2. Typical Bandpass Characteristics (Sheet 1 of 2)



C. 20KHZ FIXED WIDE BAND MODE-600 OHM INPUT IMPEDANCE



D. 70HZ AND 7HZ TUNABLE NARROW BAND MODE-50 OHM INPUT INPEDANCE

Figure 2-2. Typical Bandpass Characteristics (Sheet 2 of 2)

as illustrated in figure 2-3; their functions are described in table 2-1.

2-28. STARTING PROCEDURE - AC OPERATION. The Model NF-315 is normally factory wired to operate from a nominal 115-volt 50 to 400 Hz a-c line. Modification of such units to operate from a 230-volt line is easily accomplished by reconnecting the dual 115-volt primary windings of the power transformer from a parallel configuration (see figure 2-4a) to a series configuration (see figure 2-4b).

CAUTION

AFTER MODIFICATION REPLACE 1/4 AMP DELAY FUSE WITH 1/8 AMP DELAY FUSE AND CONSPICUOUSLY TAG MODEL NF-315 TO INDICATE IT HAS BEEN MODIFIED TO OPERATE FROM A 230-VOLT SOURCE.

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS

Control, Indicator Or Connector	Figure 2-3 Index No.	Function
WIDE BAND attenuator switch	1	Inserts or removes attenuation (0 to 100 dB in 20-dB steps) during fixed wide band mode of operation; inserts or removes input attenuation (0 to 60 dB in 20-dB steps) during tunable narrow band mode of operation.
WIDE BAND dB dial	2	Indicates dB factor which, when algebraically added to both the meter dB scale indication and the appropriate calibration curve correction factor, represents the strength of the applied signal (in dB relative to 1 uv) during fixed wide band mode of operation within the accuracy specified in table 1-5.
BANDWIDTH SELECTOR switch	3	Selects operating mode and bandwidth of Model NF-315, as follows: 250 KHZ FIXED WIDE BAND - Model NF-315 operates as an untuned wide band video receiver having a fixed bandwidth from 20 Hz to 250 kHz. This mode is employed to monitor the total signal content within the band to prevent input section overloading in the presence of high level fields or signals. 20 KHZ FIXED WIDE BAND - Model NF-315 operates as an untuned wide band video receiver having a fixed bandwidth from 20 Hz to 20 kHz. This mode is also employed to monitor signal levels within the band to prevent possible preamplifier overload when using tunable narrow band mode to evaluate signal level; 70 HZ TUNABLE NARROW BAND - Model NF-315 operates as a tunable narrow band receiver having a nominal 70 Hz bandwidth over the frequency range from 20 Hz to 15 kHz; 7 HZ TUNABLE NARROW BAND - Model NF-315 operates as a tunable narrow band receiver having a nominal 7 Hz bandwidth over the frequency range from 20 Hz to 15 kHz.

(Cont'd)

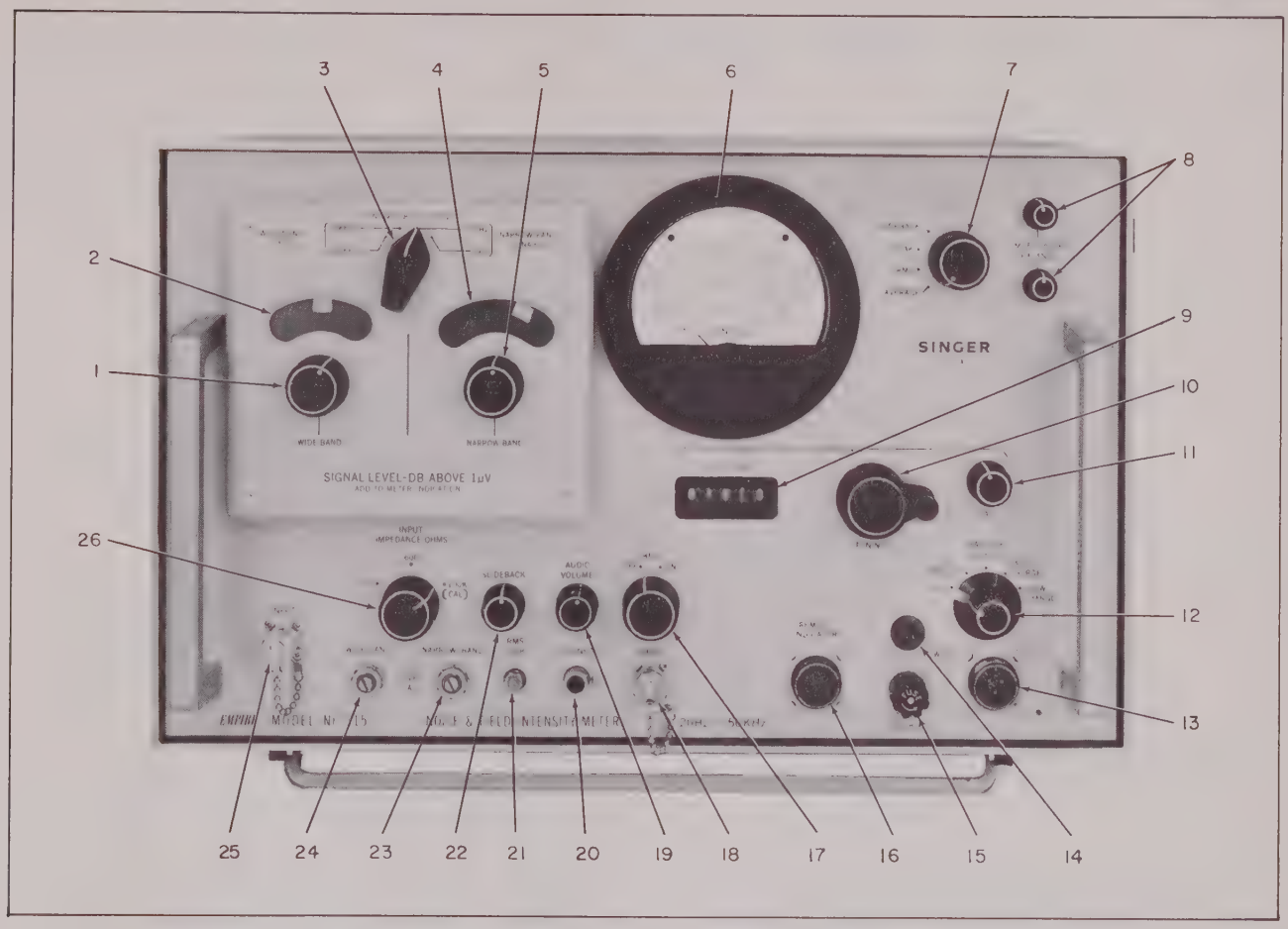


Figure 2-3. Operating Controls, Indicators and Connectors

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator Or Connector	Figure 2-3 Index No.	Function
NARROW BAND dB dial	4	Indicates dB factor which, when algebraically added to both the meter db scale indication and the appropriate calibration curve correction factor, represents the strength of the applied signal (in dB relative to 1 uv) during tunable narrow band mode of operation within the accuracy specified in table 1-5.
NARROW BAND attenuator switch	5	Inserts or removes narrow band attenuation in i-f signal line (0 to 80 dB in 20-dB steps) during tunable narrow band mode of operation.
Meter	6	Provides calibrated scales which, in conjunction with either the WIDE BAND dB dial or NARROW BAND dB dial (depending on the selected mode of operation) and the appropriate calibration curve correction factor, represents the average, rms or peak value (depending on selected detector function) of applied signal.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator Or Connector	Figure 2-3 Index No.	Function
Detector function selector switch	7	Permits the operator to measure particular value of applied signals, as follows: AVERAGE - Average value (0.636 E_{peak} for pure sinusoid) is measured; RMS - Root mean square value (0.707 E_{peak} for pure sinusoid) is measured; PEAK - Peak value of applied signal is measured; SLIDEBACK - Peak value of applied signal is measured by the metered slideback technique (in conjunction with the SLIDEBACK control, AUDIO VOLUME control, BFO switch and 600-ohm headset plugged into PHONES connector.
MODULATOR BALANCE controls	8	Adjusts operation of balanced modulator to suppress local oscillator signal feedthrough when measuring lowest frequency signals in the tunable narrow band mode of operation.
FREQUENCY 20HZ-15KHZ counter	9	Digitally indicates the frequency to which the Model NF-315 is tuned during tunable narrow band mode of operation. Accuracy of counter indication is ±(1% + 5 Hz). Note that last digit of counter readout is fixed at 0.
FREQUENCY TUNING control	10	Tunes Model NF-315 to any frequency from 20 Hz to 15 kHz (as digitally indicated on the FREQUENCY 20HZ-15KHZ counter) during tunable narrow band mode of operation.
FREQUENCY CAL control	11	Trims local oscillator frequency to 100 kHz when operating in tunable narrow band mode with the FREQUENCY TUNING control adjusted to obtain a FREQUENCY 20HZ-15KHZ dial indication of 00000.
POWER selector switch	12	Controls application of operating power to the Model NF-315, as follows: OFF - Disconnects Model NF-315 from both a-c line and internal batteries; AC OPERATE - Couples a-c line power to Model NF-315 and simultaneously applies trickle charge to internal batteries; BATTERY OPERATE - Model NF-315 is powered by internal batteries (even if line cord is connected to external a-c source);

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator Or Connector	Figure 2-3 Index No.	Function
POWER selector switch (cont'd)	12 (cont'd)	FAST CHARGE - Model NF-315 is inoperative but internal batteries are charged (in approximately 14 hours) while equipment is coupled to a-c line; SLOW CHARGE - Model NF-315 is inoperative but internal batteries are charged (in approximately 30 hours) while equipment is coupled to a-c line.
POWER connector	13	Couples a-c line power to Model NF-315.
POWER indicator lamp	14	Illuminates when a-c line power is coupled to the Model NF-315 (when POWER selector switch is set to AC OPERATE, FAST CHARGE or SLOW CHARGE).
POWER 0.25A SLO-BLO fuseholder	15	Houses a-c line fuse.
REMOTE INDICATOR connector	16	Couples meter current to a remote indicator during either tunable narrow band or fixed wide band mode of operation. Couples both meter current and analog x output voltage to an X-Y plotter (having a floating y input) during tunable narrow band mode of operation.
BFO switch	17	When set to ON this switch energizes a beat frequency oscillator which, when the Model NF-315 is tuned to a signal during the tunable narrow band mode of operation, produces a 600-Hz tone which can be monitored at the PHONES connector. Use of the beat frequency oscillator permits the evaluation of peak signal levels by the metered slideback technique and facilitates the recognition of low-level signal components in or near noise. The beat frequency oscillator also serves as an aural tuning aid when scanning the band in search of signal components.
SCOPE connector	18	Couples portion of either video signal (during fixed wide band mode of operation) or i-f signal (during tunable narrow band mode of operation) to an oscilloscope for monitoring The video signal displayed during fixed wide band operation is a true representation of the applied signal when using the rms and peak detector function and is a compressed representation when using the average detector function.
AUDIO VOLUME control	19	Adjusts overall gain of audio signal coupled to PHONES connector.
PHONES connector	20	Couples audio signals to an external 600-ohm headset when monitoring or searching for signals.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator Or Connector	Figure 2-3 Index No.	Function
RMS O DB screwdriver control	21	Calibrates rms detector by adjusting meter for SET indication on RMS scale.
SLIDEBACK control	22	Adjusts level of back-bias voltage applied to peak detector diode when measuring the peak value of a signal by the metered slideback technique. This voltage is displayed on scale.
NARROW BAND SIG LEVEL CAL screwdriver control	23	Adjusts overall gain of system when operating in the tunable narrow band mode.
WIDE BAND SIG LEVEL CAL screwdriver control	24	Adjusts overall gain of system when operating in the fixed wide band mode.
INPUT connector	25	Couples signal under measurement to the Model NF-315.
INPUT IMPEDANCE OHMS selector switch	26	Permits the operator to set the input impedance of the Model NF-315 at 50, 600, or 100,000 ohms (nominal).

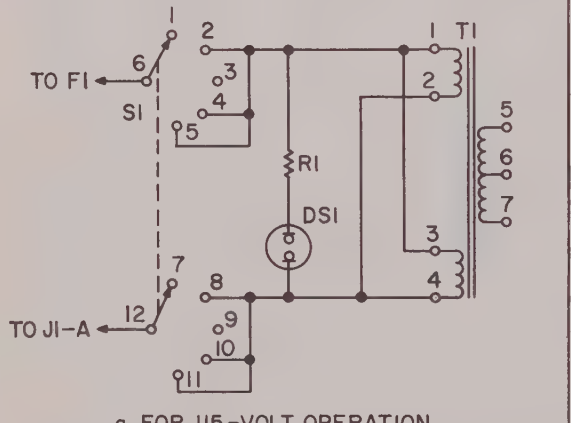


Figure 2-4. Power Transformer Wiring Diagram

2-29. With the Model NF-315 adjusted to operate from the available source voltage, set the POWER selector switch to OFF and couple the supplied line cord between the POWER connector and the source outlet. Set the POWER selector switch to AC OPERATE; the POWER indicator lamp will illuminate upon application of line power. The Model NF-315 is ready for operation since essentially no warmup time is required.

2-30. STARTING PROCEDURE - BATTERY OPERATION. If the Model NF-315 is to draw power from its self-contained batteries, set the POWER selector switch to BATTERY OPERATE. Note that the POWER indicator lamp does not illuminate.

2-31. PRELIMINARY ADJUSTMENTS. To ensure optimum measurement accuracy of the Model NF-315, perform the adjustments described in paragraphs 2-32 through 2-34. These adjustments should be performed each time the Model NF-315 is energized.

2-32. GAIN CALIBRATION. The gain of the Model NF-315 must be calibrated in conjunction with the detector function and bandwidth employed for actual signal measurements. The procedures for calibrating the gain in both the fixed wide band (surveillance) and tunable narrow band (measurement) operating modes are presented below.

a. Set the INPUT IMPEDANCE OHMS switch to 100K.

b. Set the BANDWIDTH SELECTOR switch to the

desired surveillance bandwidth (either 250KHZ FIXED WIDE BAND or 20KHZ FIXED WIDE BAND).

c. Set the Detector function selector switch to the desired detector function (either AVERAGE or PEAK).

d. Rotate the WIDE BAND attenuator switch clockwise to obtain a WIDE BAND dB dial indication of CAL.

e. Loosen the locknut that secures the setting of the WIDE BAND SIG LEVEL CAL control and, using a screwdriver, set the control to obtain a meter indication of exactly CAL on either the AVG or PEAK meter scale, as determined by the setting of the Detector function selector switch.

f. Set the BANDWIDTH SELECTOR switch to the desired measurement bandwidth (either 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND).

g. Rotate the NARROW BAND attenuator switch clockwise to obtain a NARROW BAND dB dial indication of CAL.

h. Rotate the FREQUENCY TUNING control to obtain a maximum meter indication (the FREQUENCY 20HZ-15KHZ counter should read between 600 and 1400 Hz).

i. Loosen the locknut that secures the setting of the NARROW BAND SIG LEVEL CAL control and, using a screwdriver, set the control to obtain a meter indication of exactly CAL (at maximum meter deflection) on either the AVG or PEAK meter scale, as determined by the setting of the Detector function selector switch.

2-33. METER RMS SCALE CALIBRATION. If the rms value of applied signals is to be measured, calibrate the meter RMS scale as directed in the following steps.

a. Calibrate the gain of the Model NF-315 using the average detector function in conjunction with either the 20-kHz or 250-kHz fixed wide band mode, as described in paragraph 2-32.

b. With the INPUT IMPEDANCE OHMS switch set to 100K and the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of CAL, set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND or 20KHZ FIXED WIDE BAND, as required.

c. Set the Detector function selector switch to RMS.

d. Depress the RMS 0 DB PRESS toggle switch and note the meter indication on the RMS scale - it should read SET. If the meter indication is other than SET, adjust the RMS 0 DB screwdriver control (while holding the RMS 0 DB toggle switch depressed) to obtain the proper indication of SET. Release the RMS 0 DB PRESS toggle switch.

2-34. MODULATOR BALANCING. To maximize sensitivity when evaluating low frequency signals (up to 200 Hz in the 7 Hz bandwidth and up to 500 Hz in the 70 Hz bandwidth) in the tunable narrow band mode of operation, the modulator within the narrow band circuitry must be properly balanced to suppress possible local oscillator feedthrough. This balancing procedure is contained in the following steps.

a. Set the INPUT IMPEDANCE OHMS switch to 100K.

b. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.

c. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100.

d. Set the Detector function selector switch to AVERAGE.

e. Set the BANDWIDTH SELECTOR switch to 7HZ TUNABLE NARROW BAND.

f. Rotate the FREQUENCY TUNING control counterclockwise to obtain a FREQUENCY 20HZ-15KHZ counter reading of 00000. If the meter pointer does not deflect to an on-scale indication, rotate the NARROW BAND attenuator switch counterclockwise, in 20-dB increments, until an on-scale indication is obtained.

g. Adjust the FREQUENCY CAL control to obtain a maximum meter indication. (It may be necessary to readjust the NARROW BAND attenuator switch setting to maintain an on-scale meter indication.)

h. Alternately adjust both MODULATOR BALANCE controls to obtain a minimum meter reading.

i. Repeat steps g and h until the meter is nulled, indicating that the modulator is balanced. The meter should indicate below CAL on the AVG scale when the NARROW BAND dB dial reads 60.

2-35. TWO-TERMINAL VOLTMETER MEASUREMENTS. The Model NF-315 can be employed as a two-terminal voltmeter having selectable input impedances as well as selectable bandwidths. The applicable operating procedure for making two-terminal voltmeter measurements (as a function of both bandwidth and input impedance are listed in table 2-2.

TABLE 2-2. APPLICABLE OPERATING PROCEDURES FOR TWO-TERMINAL VOLTMETER MEASUREMENTS

Bandwith	Input Impedance	Applicable Paragraph
250 kHz	100,000 Ohms	2-36
20 kHz	50, 600 or 100,000 Ohms	2-37
70 or 7 Hz	50, 600 or 100,000 Ohms	2-38 and 2-39

2-36. 250 kHz Bandwidth. To measure the amplitude of any sinusoidal signal within the frequency range from 20 Hz to 250 kHz, proceed as directed in the following steps. This procedure assumes that the frequency of the sinusoidal signal being measured is known and the Model NF-315 has been calibrated in accordance with paragraphs 2-32 and 2-33.

a. Set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND.

b. Set the INPUT IMPEDANCE OHMS switch to 100K. (Note that the 50 and 600 ohm input impedances will limit the bandwidth to 20 kHz due to the limited frequency response of the inserted input impedance matching transformer.)

c. Set the Detector function selector switch to the desired detector function (e.g., AVERAGE, RMS or PEAK). The AVERAGE position of the Detector function selector switch is recommended for most applications.

d. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.

e. Couple the sinusoidal signal to be measured to the INPUT connector.

f. Rotate the WIDE BAND attenuator switch counterclockwise, in one step increments as necessary, until the meter pointer deflects to an indication within the upper 20 dB portion of the appropriate scale.

g. The strength of the signal applied to the INPUT connector of the Model NF-315 (in dB above 1 uv) is equal to the algebraic sum of (1) the WIDE BAND dB dial indication, (2) the appropriate meter dB scale indication and (3) the applicable detector function dB correction factor obtained from the supplied calibration curves. (Refer to paragraph 2-44 for information governing the use of the calibration curves.)

2-37. 20 kHz Bandwidth. To measure the amplitude of any sinusoidal signal within the frequency range from 20 Hz to 20 kHz, proceed as directed in the following steps. This procedure assumes that the frequency of the sinusoidal signal being measured is known and the Model NF-315 has been calibrated in accordance with paragraphs 2-32 and 2-33.

a. Set the INPUT IMPEDANCE OHMS switch to the desired position (50, 600 or 100K, as required).

b. Set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND.

c. Set the Detector function selector switch to the desired detector function (e.g., AVERAGE, RMS or PEAK). The AVERAGE position of the Detector function selector switch is recommended for most applications.

d. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 (if the INPUT IMPEDANCE OHMS switch is set to 100K) or 80 (if the INPUT IMPEDANCE OHMS switch is set to either 50 or 600).

e. Couple the sinusoidal signal to be measured to the INPUT connector.

f. Rotate the WIDE BAND attenuator switch counterclockwise, in one step increments as necessary, until the meter pointer deflects to an indication within the upper 20 dB portion of the appropriate scale.

g. The strength of the signal applied to the INPUT connector of the Model NF-315 (in dB above 1 uv) is equal to the algebraic sum of (1) the WIDE BAND dB dial indication, (2) the appropriate meter dB scale indication and (3) the applicable detector function dB correction factor obtained from the supplied calibration curves. (Refer to paragraph 2-44 for information governing the use of the calibration curves.)

2-38. 70 Hz or 7 Hz Bandwidth. To measure the amplitude and frequency of sinusoidal signals or components of complex signals within the frequency range from 20 Hz to 15 kHz, proceed as directed in the following steps. This procedure assumes that the Model MF-315 has been calibrated in accordance with paragraphs 2-32 through 2-35.

a. Set the INPUT IMPEDANCE OHMS switch to the desired position (50, 600 or 100K, as required).

b. Set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND.

c. Set the Detector function selector switch to PEAK.

Note

To evaluate the peak value of applied signals by the metered slideback technique (SLIDE-BACK position of the Detector function selector switch), refer to paragraph 2-39.

d. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 (if the INPUT IMPEDANCE OHMS switch is set to 100K) or 80 (if the INPUT IMPEDANCE OHMS switch is set to either 50 or 600).

e. Couple the signal under measurement to the INPUT connector.

f. Rotate the WIDE BAND attenuator switch counterclockwise, in one step increments as necessary, until the meter pointer deflects to an indication within the upper 20 dB portion of the appropriate scale. Do not reset the WIDE BAND attenuator switch setting for the remainder of this procedure. Leaving the switch in this position insures that the input circuitry is not overloaded and is therefore free of spurious responses.

g. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00020. Set the Detector function selector

switch to the desired function. AVERAGE is recommended for general use.

h. Rotate the NARROW BAND attenuator switch fully counterclockwise.

i. Set the BANDWIDTH SELECTOR switch to either 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND, as required.

j. Slowly rotate the FREQUENCY TUNING control clockwise to scan the band in search of signals. Signal component interception will cause the meter pointer to rise upscale as the signal enters the Model NF-315 passband.

Note

For aural monitoring of applied signals, couple a 600-ohm headset to the PHONES connector and set the BFO switch to ON. A 600-Hz tone of maximum intensity will be heard when the intercepted signal component is at the center of the Model NF-315 passband. The loudness of this tone can be adjusted to a comfortable level by means of the AUDIO VOLUME control.

k. Continue rotating the FREQUENCY TUNING control clockwise until a maximum meter deflection is obtained. If the meter pointer deflects to an off-scale indication before reaching a maximum, rotate the NARROW BAND attenuator switch one step clockwise to maintain an on-scale meter indication. Alternately adjust both the FREQUENCY TUNING control and the NARROW BAND attenuator switch until a maximum meter indication is obtained.

l. The FREQUENCY 20HZ-15KHZ counter digitally indicates the frequency of the signal component being measured. The strength of the signal component (in dB above 1 uv) at the INPUT connector of the Model NF-315 is equal to the algebraic sum of (1) the NARROW BAND dB dial indication, (2) the appropriate meter dB scale indication and (3) the applicable detector function dB correction factor obtained from the supplied calibration curves. (Refer to paragraph 2-44 for information governing the use of the calibration curves.)

m. Continue rotating the FREQUENCY TUNING control clockwise. If no other signal component is adjacent to that just measured, the meter pointer will drop downscale as the intercepted signal component leaves the passband of the Model NF-315. Rotate the NARROW BAND attenuator switch counterclockwise, in one step increments, while simultaneously rotating the FREQUENCY TUNING control clockwise until the NARROW BAND attenuator switch is set fully counterclockwise and/or the meter pointer starts to deflect upscale above noise. The latter is the indication of the interception of another signal component.

n. Repeat steps k through m until all intercepted signal components within the frequency range from 20 Hz to 15 kHz have been measured.

2-39. Slideback Technique. To measure the peak value of sinusoidal or complex signal components by the metered slideback technique when employing either the 70 or 7 Hz bandwidth of the Model NF-315, follow the procedure given in paragraph 2-38. Whenever a maximum meter indication is obtained, proceed as directed in the following additional steps to evaluate the peak value by the metered slideback technique.

a. With the SLIDEBACK control rotated fully clockwise, the BFO switch set to ON and a 600-ohm headset plugged into the PHONES connector, adjust the AUDIO VOLUME control to obtain a barely audibile level of the 600-Hz tone.

b. Set the Detector function selector switch to SLIDEBACK.

c. Slowly rotate the SLIDEBACK control counterclockwise until the 600-Hz aural tone just starts to increase in volume. Do not rotate the SLIDEBACK control beyond this point.

d. Note the meter indication on the PEAK scale. The peak value of the signal component, as determined by the slideback technique, is evaluated in the same fashion as those levels measured in paragraph 2-38.

e. Rotate the SLIDEBACK control fully clockwise and return the Detector function selector switch to the detector function employed when searching for signal components.

f. Repeat steps b through e for all other intercepted signal components within the frequency range from 20 Hz to 15 kHz.

2-40. NOISE AND FIELD INTENSITY MEASUREMENTS. The Model NF-315, when used in conjunction with available calibrated pickup devices (antennas or probes), will measure the strength of electromagnetic fields within the tunable narrow band frequency range from 20 Hz to 15 kHz. The applicable operating procedure for making field intensity measurements (as a function of antenna or probe employed) are listed in table 2-3.

2-41. Radiated Field Measurements - Electric Component. To measure the strength of the electric component of a radiated field in conjunction with the Model CA-315 Capacitive Antenna, proceed as directed in the following steps. This procedure assumes that the Model NF-315 has been calibrated in accordance with paragraphs 2-32 through 2-34.

a. Set the INPUT IMPEDANCE OHMS switch to 100K.

b. Set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND.

c. Set the Detector function selector switch to PEAK.

d. Set the WIDE BAND attenuator switch to obtain

TABLE 2-3. APPLICABLE OPERATING PROCEDURES FOR NOISE AND FIELD INTENSITY MEASUREMENTS

Type of Field to be Measured	Pickup Device Employed	Applicable Paragraph
Radiated field-electric component	Model CA-315 Capacitive Antenna	2-41
Radiated field-magnetic component	Model LW-315 Loop Antenna	2-42
Conductor Currents	Model CP-315 Clamp-on Probe	2-43

a WIDE BAND dB dial indication of 100.

e. Couple the output of the Model CA-315 Capacitive Antenna to the INPUT connector of the Model NF-315. Note the indication of the meter on the PEAK scale. The meter pointer should not deflect to an indication greater than 24 on the PEAK scale. If it does, the Model CA 315 Capacitive Antenna is intercepting an electric field that exceeds the rating of the capacitive antenna. Signal distortion may result if the capacitive antenna is used to measure such high level fields.

f. If the indication of step e was a meter PEAK scale reading of 24 dB or less, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND.

g. Set the INPUT IMPEDANCE OHMS switch to 50.

h. Rotate the WIDE BAND attenuator switch counterclockwise, in one step increments as necessary, until the meter pointer deflects to an indication within the upper 20 dB portion of the PEAK scale. Do not reset the WIDE BAND attenuator switch setting for the remainder of this procedure.

i. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00020.

j. Rotate the NARROW BAND attenuator switch fully counterclockwise.

k. Set the BANDWIDTH SELECTOR switch to either 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND, as required, and set the Detector function selector switch to the desired detector function.

l. Slowly rotate the FREQUENCY TUNING control clockwise to scan the band in search of fields. Field component interception will cause the meter pointer to rise upscale as the signal enters the Model NF-315 passband.

Note

For aural monitoring of applied signals, couple a 600-ohm headset to the PHONES connector and set the BFO switch to ON. A 600-Hz tone of maximum intensity will be heard when the signal component is at the center of the Model NF-315 passband. The loudness of the tone can be adjusted to a comfortable level by means of the AUDIO VOLUME control.

m. Continue rotating the FREQUENCY TUNING control clockwise until a maximum meter deflection is obtained. If the meter pointer deflects to an off-scale indication before reaching a maximum, rotate the NARROW BAND attenuator switch one step clockwise to maintain an on-scale meter indication. Alternately adjust both the FREQUENCY TUNING control and the NARROW BAND attenuator switch until a maximum meter indication is obtained.

n. The FREQUENCY 20HZ-15KHZ counter digitally indicates the frequency of the intercepted field component. The voltage induced in the 41-inch rod of the capacitive antenna (in dB above 1 uv) by the intercepted field component is equal to the algebraic sum of (1) the NARROW BAND dB dial indication, (2) the meter dB scale indication, (3) the detector function dB correction factor obtained from the supplied calibration curves and (4) the antenna factor of the Model CA-315 Capacitive Antenna at the frequency of measurement. (Refer to paragraphs 2-44 and 2-45 for information governing the use of the calibration curves and antenna factors.) To determine the actual electric field strength (in dB above 1 uv/meter) from the induced voltage value, add 6 dB (the effective height factor for the 41-inch rod) to the induced voltage.

o. Continue rotating the FREQUENCY TUNING control clockwise. If no other field component is adjacent to that just measured, the meter pointer will drop downscale as the intercepted field component signal passes from the passband of the Model NF-315. Rotate the NARROW BAND attenuator switch counterclockwise, in one step increments, while simultaneously rotating the FREQUENCY TUNING control clockwise until the NARROW BAND attenuator switch is set fully counterclockwise and/or the meter pointer starts to deflect upscale above noise. The latter is indicative of the interception of another field component.

p. Repeat steps m through o until all intercepted field components of interest within the frequency range from 20 Hz to 15 kHz have been measured.

2-42. Radiated Field Measurements-Magnetic Component. To measure the strength of the magnetic

component of a radiated field in conjunction with the Model LW-315 Loop Antenna, proceed as directed in the following steps. This procedure assumes that the Model NF-315 has been calibrated in accordance with paragraphs 2-32 through 2-34.

a. Set the INPUT IMPEDANCE OHMS switch to 50.

b. Set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND.

c. Set the Detector function selector switch to the desired detector function (AVERAGE or PEAK).

d. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80.

e. Couple the output of the Model LW-315 Loop Antenna to the INPUT connector of the Model NF-315.

f. Rotate the WIDE BAND attenuator switch counterclockwise, in one step increments as necessary, until the meter pointer deflects to an indication within the upper 20 dB portion of the scale.

g. Rotate the Model LW-315 Loop Antenna to obtain a maximum meter indication. It may be necessary to reset the WIDE BAND attenuator switch to maintain an on-scale meter indication. Do not reset the WIDE BAND attenuator switch setting for the remainder of this procedure.

h. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00020.

i. Set the BANDWIDTH SELECTOR switch to either 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND, as required.

j. Slowly rotate the FREQUENCY TUNING control clockwise to scan the band in search of fields. Field component interception will cause the meter pointer to rise upscale as the signal enters the Model NF-315 passband.

Note

For aural monitoring of applied signals, couple a 600-ohm headset to the PHONES connector and set the BFO switch to ON. A 600-Hz tone of maximum intensity will be heard when the signal component is at the center of the Model NF-315 passband.

k. Continue rotating the FREQUENCY TUNING control clockwise until a maximum meter deflection is obtained. If the meter pointer deflects to an off-scale indication before reaching a maximum, rotate the NARROW BAND attenuator switch one step clockwise to maintain an on-scale meter indication. Alternately adjust both the FREQUENCY TUNING control and the NARROW BAND attenuator switch until a maximum meter indication is obtained.

l. The FREQUENCY 20HZ-15KHZ counter digitally indicates the frequency of the intercepted field component. The field strength (in dB above 1 uv/meter) of the intercepted field component is equal to the algebraic sum of (1) the NARROW BAND dB dial indication, (2) the meter dB scale indication, (3) the detector function dB correction factor obtained from the calibration curves supplied and (4) the antenna factor for the Model LW-315 Loop Antenna at the frequency of measurement. (Refer to paragraphs 2-44 and 2-45 for information regarding the use of the calibration curves and antenna factors.)

Note

If the intercepted field component is from more than one source, it will be necessary to orient the loop antenna each time a field component is being measured.

m. Continue rotating the FREQUENCY TUNING control clockwise. If no other field component is adjacent to that just measured, the meter pointer will drop downscale as the intercepted field component leaves the passband of the Model NF-315. Rotate the NARROW BAND attenuator switch counterclockwise, in one step increments, while simultaneously rotating the FREQUENCY TUNING control clockwise until the NARROW BAND attenuator switch is set fully counterclockwise and/or the meter pointer starts to deflect upscale above noise. The latter is indicative of the interception of another radiated field component.

n. Repeat steps k through m until all intercepted field components within the frequency range from 20 Hz to 15 kHz have been measured.

2-43. Conducted Current Measurements. To measure the amplitude and frequency of currents flowing within a conductor, proceed as directed in the following steps.

a. Set the INPUT IMPEDANCE OHMS switch to 50.

b. Set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND.

c. Set the Detector Function selector switch to the desired detector function (AVERAGE or PEAK).

d. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 0.

e. Spring back the hasp to open the split core secondary of the Model CP-315 Clamp-on Probe. Place the open secondary of the probe around the conductor to be measured and close the probe frimly so the hasp snaps shut.

Note

Do not permit the probe to touch the metal parts of any equipment, shield braid or ground plane.

f. Couple the output of the Model CP-315 Clamp-on Probe to the INPUT connector of the Model NF-315.

g. Rotate the WIDE BAND attenuator switch counterclockwise, in one step increments as necessary, until the meter pointer deflects to an indication within the upper 20 dB portion of the scale. Do not reset the WIDE BAND attenuator switch setting for the remainder of this procedure.

h. Adjust ehe FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00020.

i. Set the BANDWIDTH SELECTOR switch to either 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND, as required.

j. Slowly rotate the FREQUENCY TUNING control clockwise to scan the band in search of signals. Signal component interception will cause the meter pointer to rise upscale as the signal enters the Model NF-315 passband.

Note

For aural monitoring of applied signals, couple a 600-ohm headset to the PHONES connector and set the BFO switch to ON. A 600-Hz tone of maximum intensity will be heard when the signal component is at the center of the Model NF-315 passband. The loudness of this tone can be adjusted to a comfortable level by means of the AUDIO VOLUME control.

k. Continue rotating the FREQUENCY TUNING control clockwise until a maximum meter indication is obtained. If the meter pointer deflects to an off-scale indication before reaching a maximum, rotate the NARROW BAND attenuator switch one step clockwise to maintain an on-scale meter indication. Alternately adjust both the FREQUENCY TUNING control and the NARROW BAND attenuator switch until a maximum meter indication is obtained.

l. The FREQUENCY 20HZ-15KHZ counter digitally indicates the frequency of the intercepted signal component. The current flowing in the conductor (in dB above 1 microampere) is equal to the algebraic sum of (1) the NARROW BAND dB dial indication, (2) the meter dB scale indication, (3) the detector function dB correction factor obtained from the supplied calibration curves and (4) the transfer admittance factor for the Model CP-315 Clamp-on Probe at the frequency of measurement. (Refer to paragraphs 2-44 and 2-45 for information regarding the use of the calibration curves and the probe factor.)

m. Continue rotating the FREQUENCY TUNING control clockwise. If no other signal component is adjacent to that just measured, the meter pointer will drop downscale as the intercepted signal component leaves the passband of the Model NF-315. Rotate the NARROW BAND attenuator switch counterclockwise, in one step increments, while simultaneously rotating the FREQUENCY TUNING control clockwise until the NARROW BAND attenuator switch is set fully counterclockwise and/or the meter pointer starts to deflect upscale above noise. The latter is indicative of the interception of another signal component.

n. Repeat steps k through m until all intercepted signal components within the frequency range from 20 Hz to 15 kHz have been measured.

2-44. CALIBRATION CURVES AND ANTENNA AND PROBE FACTORS. To determine the level of applied signal at the INPUT connector of the Model NF-315 (when employed as a two-terminal voltmeter) with the greatest possible measurement accuracy, a correction factor must be added to the algebraic sum of the appropriate meter scale dB indication and either WIDE BAND or NARROW BAND dB dial indication. Table 2-4 lists the applicable correction factor as a

TABLE 2-4. APPLICABLE CORRECTION FACTOR AS A FUNCTION OF SELECTED INPUT IMPEDANCE AND BANDWIDTH

Input Impedance Selected	Bandwidth Selected	Applicable Correction Factor
100,000 Ohms	250KHZ FIXED WIDE BAND	Figure 2-5a
100,000 Ohms	20KHZ FIXED WIDE BAND	Figure 2-5b
100,000 Ohms	70 or 7HZ TUNABLE NARROW BAND	Figure 2-5c
600 Ohms	20KHZ FIXED WIDE BAND	Figure 2-6a
600 Ohms	70 or 7HZ TUNABLE NARROW BAND	Figure 2-6b
50 Ohms	20KHZ FIXED WIDE BAND	Figure 2-7a
50 Ohms	70 or 7HZ TUNABLE NARROW BAND	Figure 2-7b

function of input impedance and bandwidth selected.

2-45. The field strength (when using either the Model CA-315 Capacitive Antenna or the Model LW-315 Loop Antenna) or current in a conductor (when using the Model CP-315 Clamp-on Probe) can be evaluated by adding the appropriate factor to the two-terminal voltage indication of the Model NF-315. The applicable factor for the selected pickup device is listed in table 2-5.

2-46. STOPPING PROCEDURE. To shut down the Model NF-315, simply rotate the POWER selector switch fully counterclockwise to the OFF position. The POWER indicator lamp will go out when line power is removed from the equipment (if the Model NF-315 was powered from an a-c source).

Note

If the Model NF-315 was powered from its internal batteries, recharge the batteries by coupling the equipment to a-c line power and set the POWER selector switch to either FAST CHARGE or SLOW CHARGE, as required. The POWER indicator lamp will light while the batteries are being recharged.

2-47. PACKAGING INSTRUCTIONS.

2-48. SHORT TERM STORAGE. If the Model NF-315 is to be stored for a short time, secure the dust cover to the equipment case. Cover the Model NF-315 with suitable protective covering such as a sheet of paper or plastic and store the equipment in a clean and dry area that is not subject to extreme temperature variations.

2-49. LONG TERM STORAGE OR SHIPMENT. If the Model NF-315 is to be stored for a long time, or shipped, proceed as directed in the following steps.

a. If the original wrappings and carton have been saved, package the equipment as illustrated in figure 2-11.

b. If new packing material is to be employed, first wrap the Model NF-315 in a moistureproof barrier such as a plastic bag. Place the equipment in a suitable box or carton and fill all empty spaces with suitable filler material to prevent possible shifting of the equipment. Seal the box or carton. Should conditions warrant rugged packaging, enclose the sealed box or carton in an outer wooden crate or metal transit case.

TABLE 2-5. APPLICABLE FACTOR FOR SELECTED PICKUP DEVICE

Pickup Device Employed	Applicable Antenna or Probe Factor
Model CA-315 Capacitive Antenna	Figure 2-8
Model LW-315 Loop Antenna	Figure 2-9
Model CP-315 Clamp-on Probe	Figure 2-10

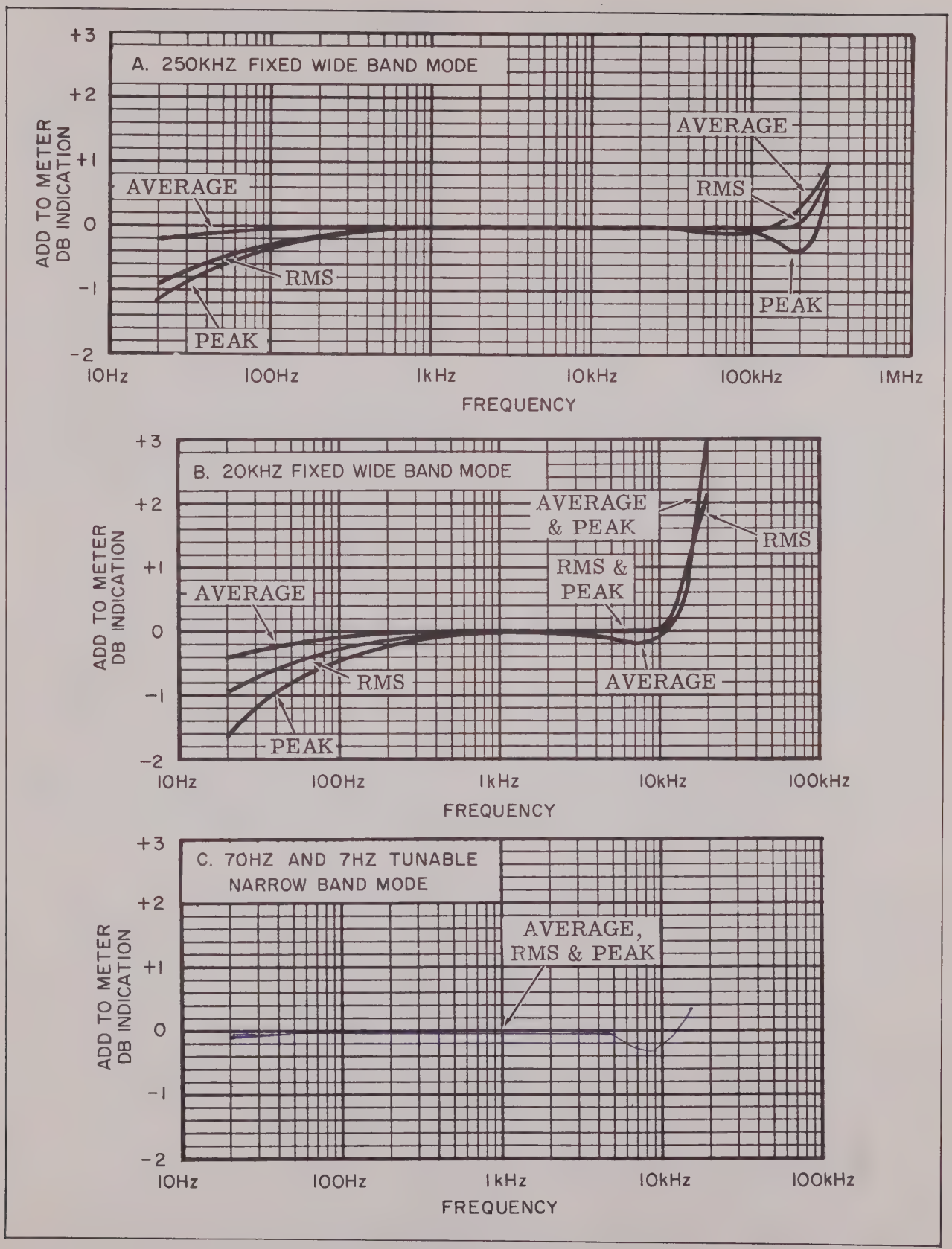


Figure 2-5. 100,000-Ohm Input Impedance Calibration Curves

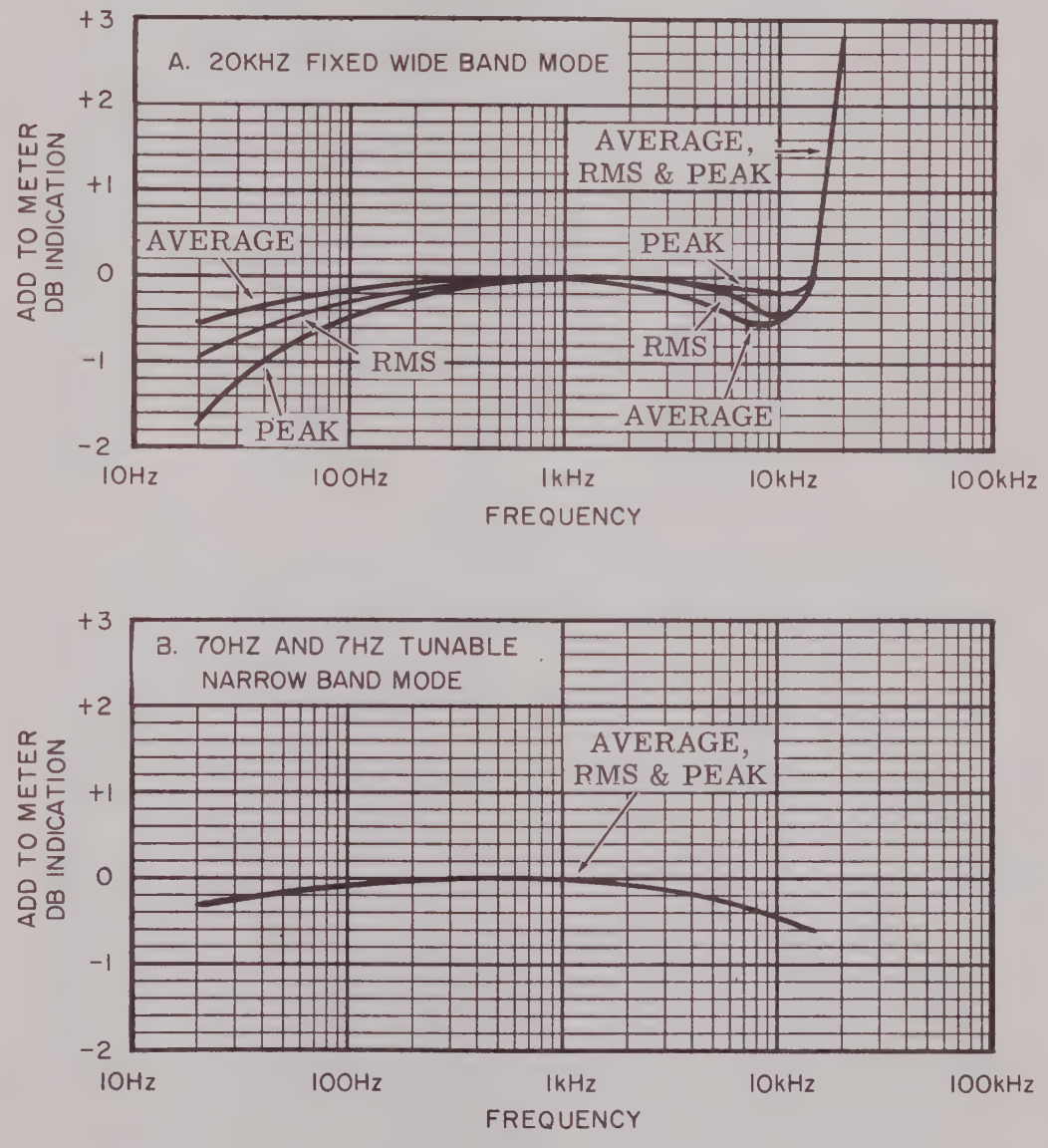


Figure 2-6. 600-Ohm Imput Impedance Calibration Curves

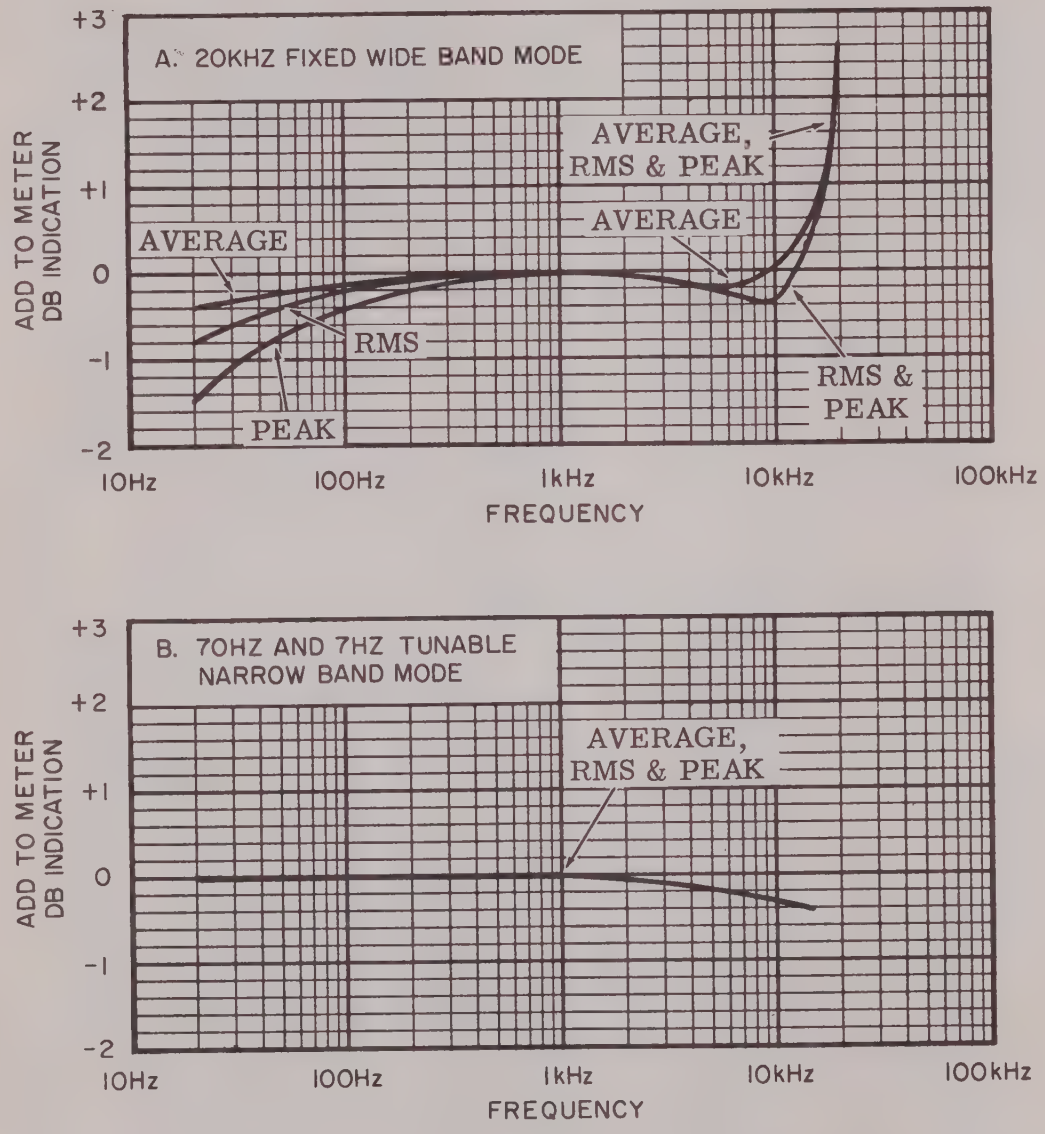


Figure 2-7. 50-Ohm Input Impedance Calibration Curves

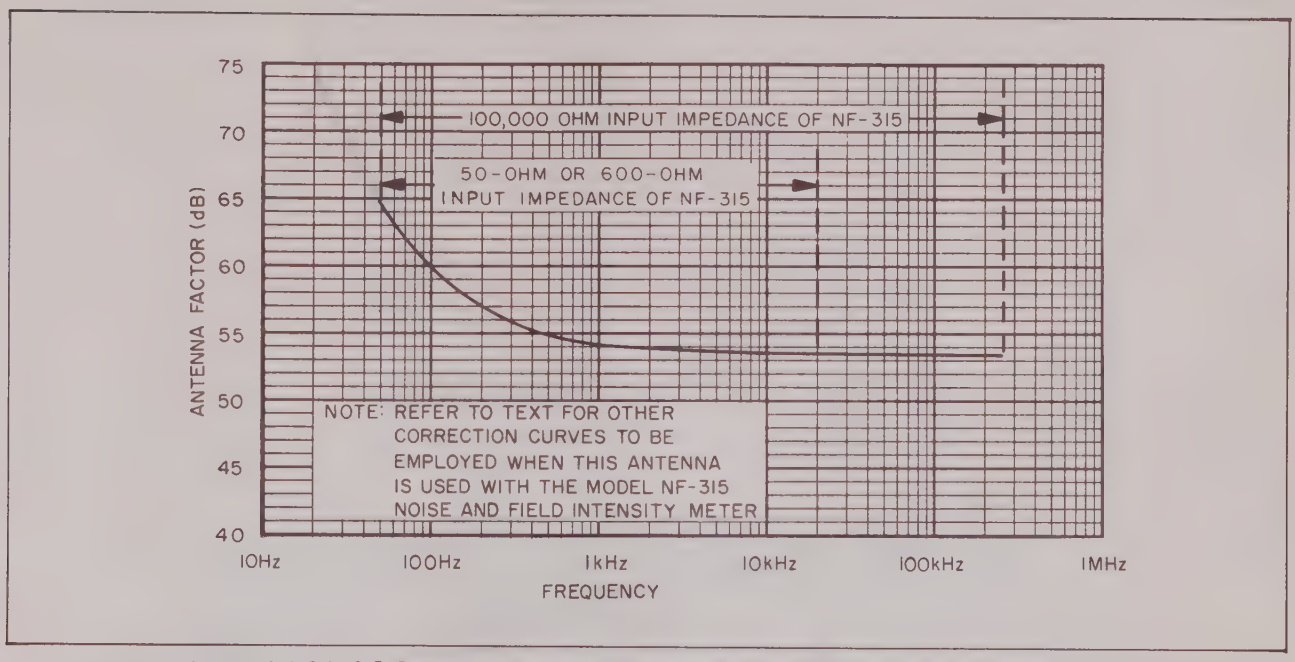


Figure 2-8. Model CA-315 Capacitive Antenna, Antenna Factor Vs. Frequency Characteristic Curve

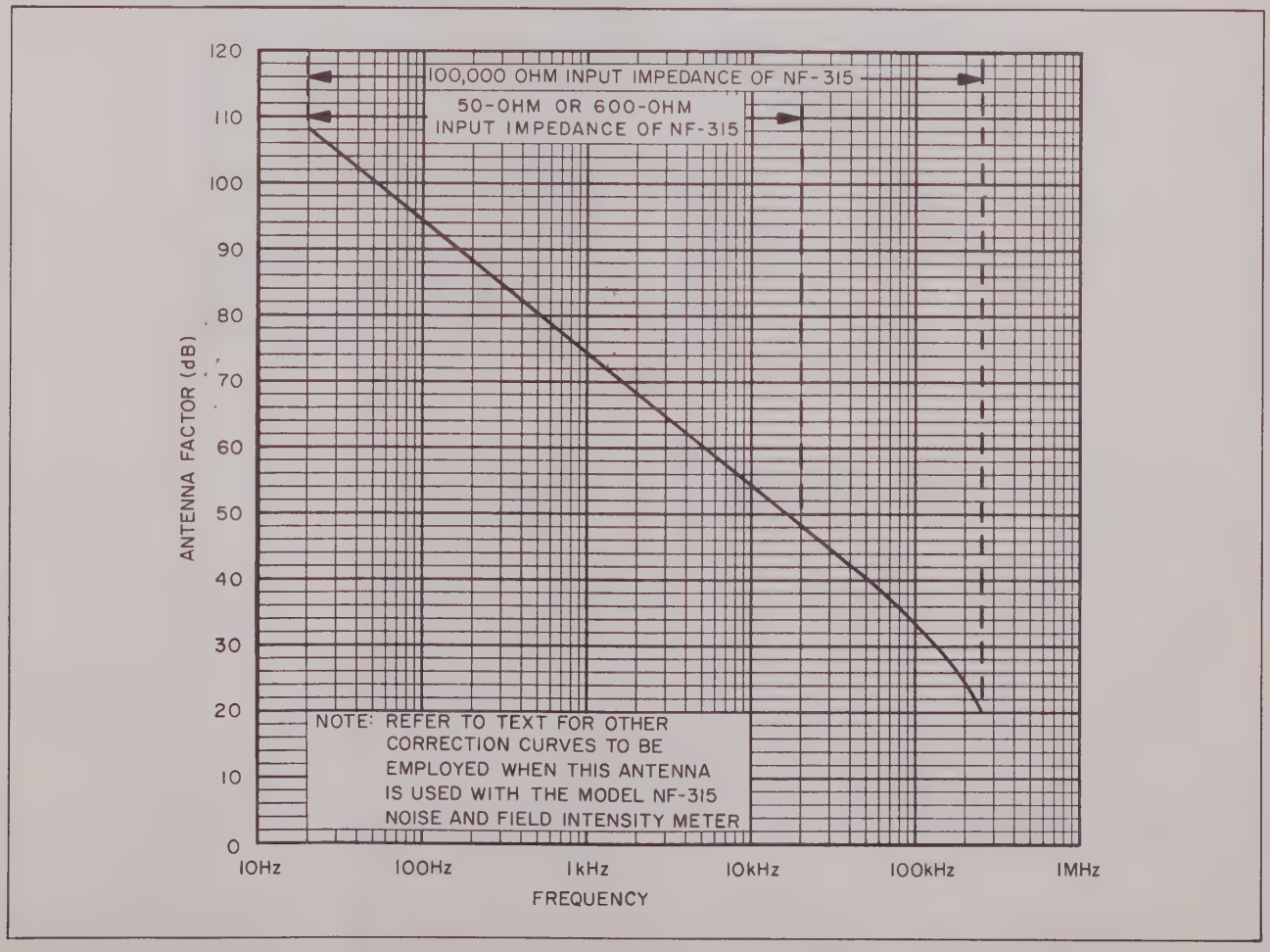


Figure 2-9. Model LW-315 Loop Antenna, Antenna Factor Vs. Frequency Characteristic Curve

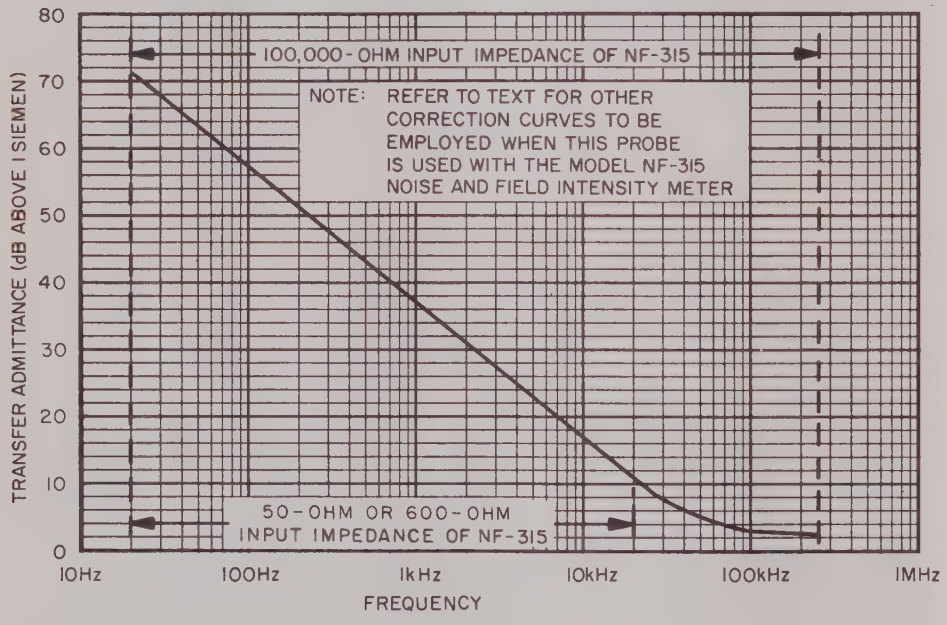


Figure 2-10. Model CP-315 Clamp-on Probe, Transfer Admittance Vs. Frequency Characteristic Curve

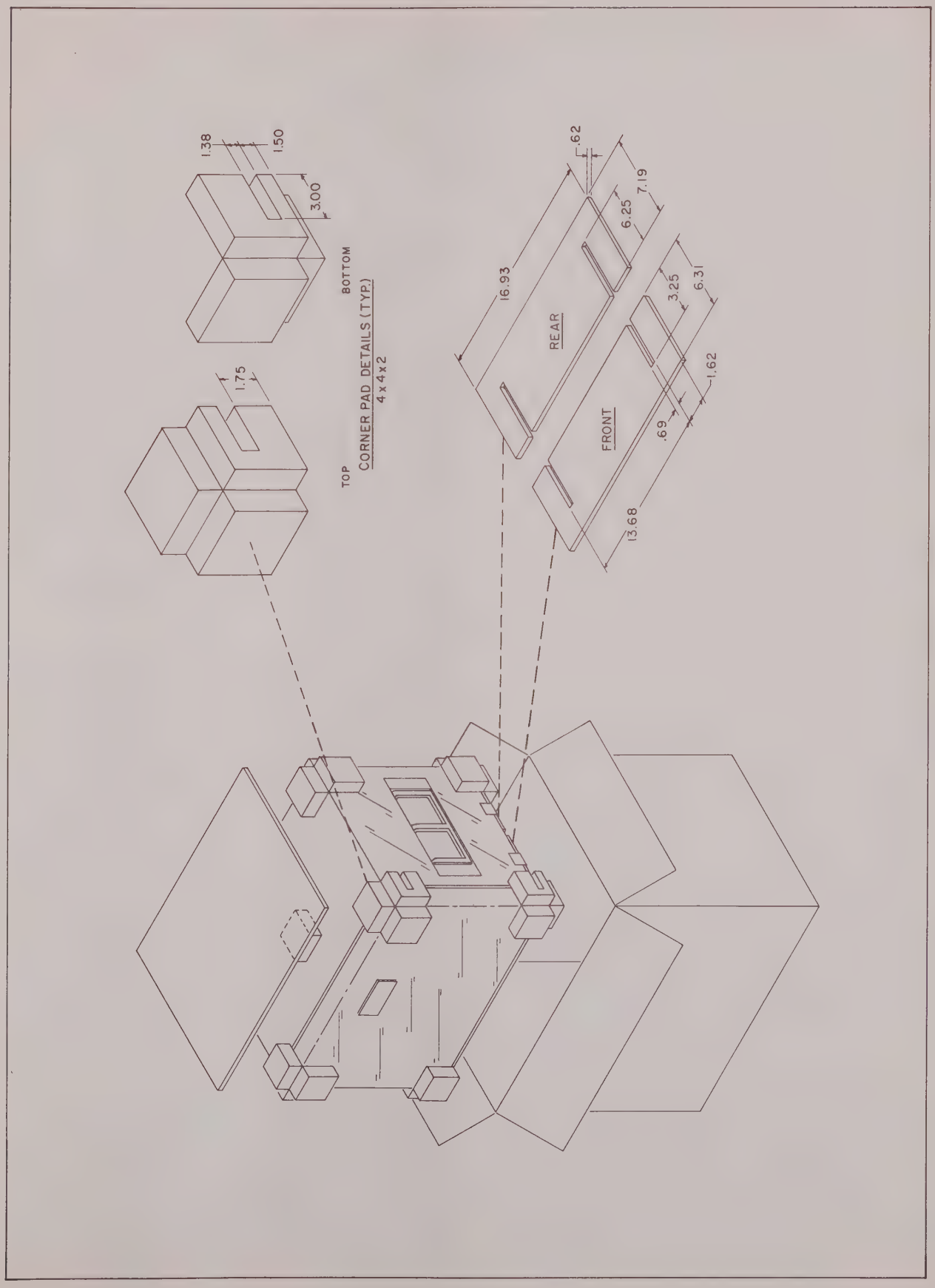


Figure 2-11. Packaging Diagram

SECTION III
THEORY OF OPERATION

3-1. GENERAL.

3-2. The Model NF-315 is a highly versatile Noise and Field Intensity Meter which combines both a complete wide band video receiver and a tunable narrow band superheterodyne receiver. The equipment can be used in either of two basic modes - fixed wide band for signal surveillance and tunable narrow band for signal measurement - with two bandwidths provided for each mode. In the fixed wide band surveillance mode the Model NF-315 measures the composite strength of all signals within the frequency band from 20 Hz to either 250 kHz or 20 kHz. In the tunable narrow band measurement mode the component strength of signals within any 70- or 7-Hz (nominal) bandwidth segment within the frequency range from 20 Hz to 15 kHz can be evaluated.

3-3. SIMPLIFIED BLOCK DIAGRAM ANALYSIS. . (See Figure 3-1.)

3-4. The Model NF-315 consists of four major signal processing circuits, as illustrated in figure 3-1. Signals to be measured are coupled through the INPUT connector and applied to an input impedance matching network which, in conjunction with the INPUT IMPEDANCE OHMS switch, reflects the 100,000 ohm impedance looking into the input attenuator as either 100,000, 600 or 50 ohms looking into the INPUT connector. The output of the matching network is coupled to a broadband input attenuator which inserts up to 60 dB of attenuation into the signal path prior to its application to a broadband low-noise preamplifier. The input attenuator serves to protect the preamplifier from overload caused by the application of high level signal components. When the equipment is operating in the 20-kHz bandwidth fixed wide band mode or either the 70- or 7-Hz bandwidth tunable narrow band mode, a 20-kHz low-pass filter is inserted into the input signal path ahead of the preamplifier. This filter attenuates all applied signal frequency components above 20 kHz, thereby permitting the measurement of low level in-band signals in the presence of high level out of band signals.

3-5. When the BANDWIDTH SELECTOR switch is set to either 250KHZ FIXED WIDE BAND or 20KHZ FIXED WIDE BAND, the output of the preamplifier is routed through a wide band attenuator to a wide band amplifier. Both the wide band attenuator and the broadband input attenuator are controlled by the WIDE BAND attenuator switch and permit the operator to insert up to 100 dB of attenuation, in 20-dB steps, in the signal path when the equipment is in the fixed wide band mode of operation. The first 60 dB is inserted by the broadband input attenuator and the last 40 dB by the wide band attenuator. The output of the wide band amplifier is coupled through either a 250- or 20-kHz low-pass filter, depending on the setting of the BANDWIDTH SELECTOR switch, and applied to a broadband driver amplifier (refer to paragraph 3-7).

3-6. When the BANDWIDTH SELECTOR switch is set to either 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND, the output of the low-noise preamplifier is routed to a balanced modulator through a 15-kHz low-pass filter. The output of a tunable local oscillator is simultaneously applied to the balanced modulator. The operating frequency of the local oscillator is continuously tunable from 100 to 115 kHz by means of the FREQUENCY TUNING control. A FREQUENCY 20HZ-15KHZ counter, which is mechanically linked to the FREQUENCY TUNING control, digitally indicates a frequency that is 100-kHz below that of the local oscillator. The heterodyning action of the balanced modulator produces the sum and difference frequencies of the local oscillator and applied signal frequencies. These mixing products are applied to an input crystal filter which passes only a narrow band of signals centered about the 100-kHz difference frequency. The 100-kHz output of the crystal filter is then applied to two successive stages of i-f attenuation and i-f amplification. Both i-f amplifier stages employ crystal filters at their outputs to limit the overall 3-dB bandwidth of the 100-kHz i-f signal to nominally 70 or 7 Hz, depending on the setting of the BANDWIDTH SELECTOR switch. Both sections of the narrow band (i-f) attenuator are ganged to the NARROW BAND attenuator switch, permitting the operator to insert up to 80 dB of attenuation, in 20-dB steps, into the 100-kHz i-f signal path. This 80 dB of narrow band attenuation plus the 60 dB of input attenuation provides a total of 140 dB of attenuation which can be inserted in the signal path during the tunable narrow band mode of operation. The output of the final i-f amplifier crystal filter is applied through the BANDWIDTH SELECTOR switch to a broadband driver amplifier.

3-7. The output of either the wide band amplifier or the final i-f amplifier crystal filter, depending on the setting of the BANDWIDTH SELECTOR switch, is then applied to a broadband driver amplifier through a gain equalization network. The gain equalization network compensates for the variation in overall gain between the 100,000-ohm input impedance and both the 600 and 50-ohm impedance produced by the insertion of the step-up input impedance matching transformer. The output of the driver amplifier is

routed to an average, rms or peak detector, as determined by the setting of the Detector function selector switch. These detectors produce a d-c output voltage proportional to the signal amplitude parameter selected. When the Detector function selector switch is set to SLIDEBACK, a d-c bucking voltage is applied to the peak detector. The magnitude of this bucking voltage is adjusted by means of the SLIDEBACK control until the peak detector is just cut off. When cutoff is achieved, the magnitude of the d-c bucking voltage is equal to the peak value of the signal applied to the peak detector. The output of the selected detector, or the d-c slideback voltage, is applied to a log amplifier which transforms the linear detector output voltage into a logarithmic voltage function necessary to drive a meter that is linearly calibrated in dB. The algebraic sum of the appropriate meter dB scale indication and either the WIDE BAND dB dial indication (when the BANDWIDTH SELECTOR switch is set to 250KHZ FIXED WIDE BAND or 20KHZ FIXED WIDE BAND) or the NARROW BAND dB dial indication (when the BANDWIDTH SELECTOR switch is set to 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND) is equal to the magnitude, in dB relative to 1 microvolt, of the signal coupled to the INPUT connector.

3-8. The overall gain of the equipment is standardized by means of a self-contained calibration oscillator which is operative only when the WIDE BAND attenuator switch is set fully clockwise to obtain a WIDE BAND dB dial indication of CAL. This simultaneously shorts the applied signal to ground and couples a 1-kHz calibration signal to the preamplifier. When the equipment is operating in either fixed wide band mode, the gain of the system is adjusted by means of the WIDE BAND SIG LEVEL CAL screwdriver control, in conjunction with either the peak or average detector, to obtain a meter dB scale indication of CAL. When the gain of either tunable narrow band mode is to be standardized, both the WIDE BAND and NARROW BAND attenuator switches are set fully clockwise to obtain WIDE BAND and NARROW BAND dB dial indications of CAL. The gain of the system is then adjusted by means of the NARROW BAND SIG LEVEL CAL screwdriver control, in conjunction with either the average or peak detector, to obtain a meter dB scale indication of CAL. The rms detector is calibrated by applying a 1-kHz reference voltage (when the RMS 0 DB PRESS toggle switch is depressed) and adjusting the RMS 0 DB control to obtain a meter RMS scale indication of SET.

3-9. Scanning or searching for the presence of signals (when the Model NF-315 is operating in either tunable narrow band mode) is facilitated by means of a beat frequency oscillator which is energized when the BFO switch is set to ON. The oscillator generates a 100.600-kHz signal which heterodynes with the 100-kHz i-f signal (if present) to produce a 600-Hz tone. This beat note is coupled through an audio amplifier to the PHONES connector, where it is made available for monitoring in conjunction with a 600-ohm headset. A portion of the wide band driver amplifier output is coupled to the SCOPE connector to permit visual monitoring of either the composite applied signal (during fixed wide band operation) or the i-f signal (during tunable narrow band operation) on an external oscilloscope. Both the meter driving current and an analog x-output voltage are available at the REMOTE INDICATOR connector for application to either a remote indicator or an external x-y plotter. The analog x-output voltage is a d-c voltage that varies linearly from 0 to 10 volts as a function of the FREQUENCY 20HZ-15KHZ counter indication.

3-10. DETAILED THEORY OF OPERATION, INPUT SECTION. (See Figures 3-2 and 5-1.)

3-11. INPUT IMPEDANCE MATCHING NETWORK. Signals to be measured are coupled through INPUT connector J1 and applied to an impedance matching network consisting of wafer A of INPUT IMPEDANCE OHMS switch A4S1 and tapped primary step-up transformer A4T1. When the INPUT IMPEDANCE OHMS switch is set to 100K, the applied signal is fed directly to a broadband input attenuator (refer to paragraph 3-14) which has an input impedance of 100,000 ohms. When the INPUT IMPEDANCE OHMS switch is set to either 600 or 50, the applied signal is impressed across either the full primary winding or tapped primary winding, respectively, of step-up transformer A4T1. The turns ratio of the transformer is such that the 100,000-ohm secondary load is reflected as a 600- or 50-ohm impedance, depending on the setting of the INPUT IMPEDANCE OHMS switch, seen looking into the INPUT connector. The impedance matching transformer, being a step-up device, introduces signal sensitivity improvements of approximately 22 and 37 dB for the 600- and 50-ohm input impedances, respectively, compared with that for the 100,000-ohm input impedance. Subsequent gain equalization networks (refer to paragraph 3-27) are employed to fix the signal sensitivity improvement differential between the 100,000-ohm input impedance and both the 600- and 50-ohm input impedances at 20 dB. Since the input impedance matching transformer frequency response rolls off sharply at frequencies above 20 kHz, bandwidth limiting will result when the equipment is adjusted to operate in the 250-kHz fixed wide band mode in conjunction with either the 600- or 50-ohm input impedence.

3-12. BROADBAND INPUT ATTENUATOR. The output of the impedance matching network is coupled to a broadband ladder (tapped L-section) input step attenuator consisting of wafers A and B of WIDE BAND attenuator switch A2S1, variable capacitor A2C2 and precision resistors A2R1 through A2R4. The input attenuator has a characteristic input impedance of 100,000 ohms and is terminated by either 20-kHz low-pass filter A1A10A1 (refer to paragraph 3-14) or broadband low-noise preamplifier A1A10 (refer to paragraph 3-15), as determined by the setting of the BANDWIDTH SELECTOR switch. Both the low-pass filter and the low-noise preamplifier have input impedances of 100,000 ohms. The amount of input attenuation inserted into the applied signal

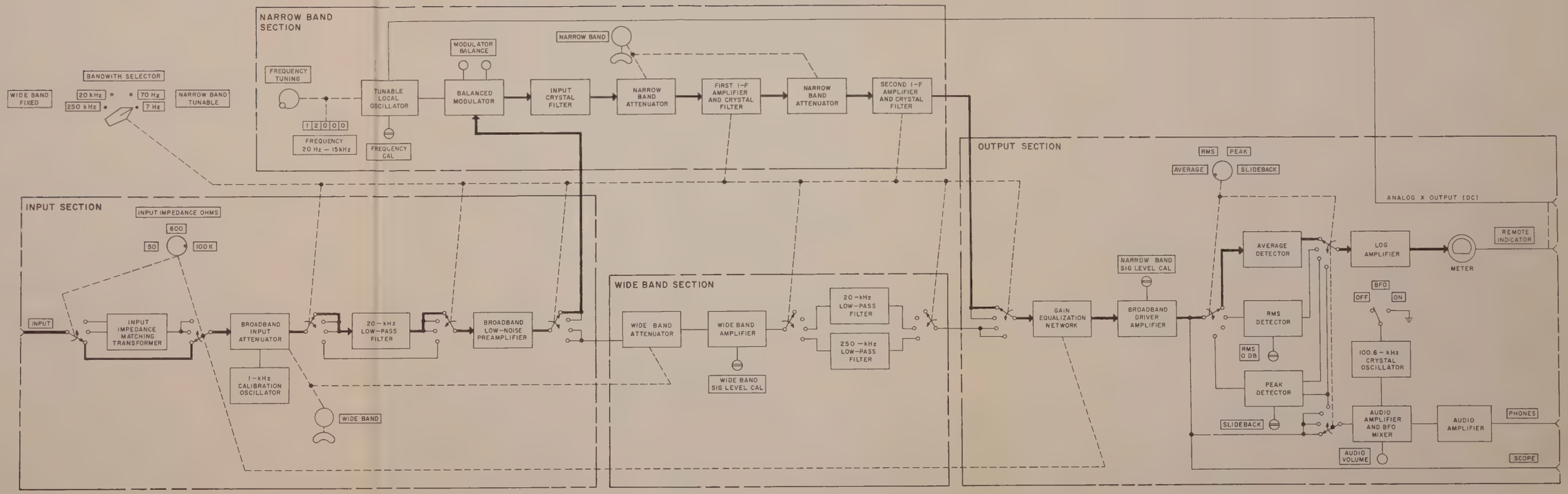


Figure 3-1. Model NF-315 Noise and Field Intensity Meter, Simplified Block Diagram

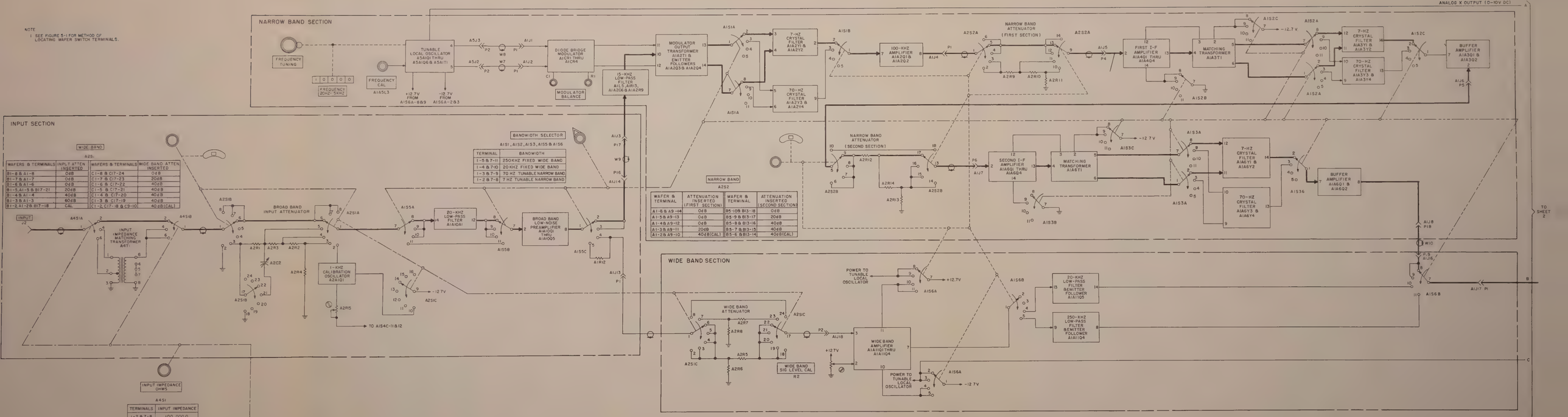

NOTE
1 SEE FIGURE 5-1 FOR METHOD OF LOCATING WAFER SWITCH TERMINALS.
NARROW BAND SECTION
FREQUENCY TUNING
FREQUENCY CAL
FREQUENCY 20HZ-5KHZ
A1A5L3
TUNABLE LOCAL OSCILLATOR A5A1Q1 THRU A5A1Q6 & A5A1I
+12.7V FROM A1S8A-8&9
-12.7V FROM A1S6A-2&3
DIODE BRIDGE MODULATOR A1CR1 THRU A1CR4
MODULATOR BALANCE
15-KHZ LOW-PASS FILTER A1L5,A1R3, A1A2C6 & A1A2R9
MODULATOR OUTPUT TRANSFORMER A1A2T1 & EMITTER FOLLOWERS A1A2Q3 & A1A2Q4
7-HZ CRYSTAL FILTER A1A2T1 & A1A2T2
70-HZ CRYSTAL FILTER A1A2T3 & A1A2Y4
100-KHZ AMPLIFIER A1A2Q1 & A1A2Q2
NARROW BAND ATTENUATOR (FIRST SECTION)
A2R9
A2R10
A2R11
FIRST I-F AMPLIFIER A1A4Q1 THRU A1A4Q4
MATCHING TRANSFORMER A1A3T1
7-HZ CRYSTAL FILTER A1A3Y1 & A1A3Y2
70-HZ CRYSTAL FILTER A1A3Y3 & A1A3Y4
BUFFER AMPLIFIER A1A3Q1 & A1A3Q2
ANALOG X OUTPUT (0-10V DC)
INPUT SECTION
WIDE BAND
A2S1
WAFERS & TERMINALS | INPUT ATTEN INSERTED | WAFERS & TERMINALS | WIDE BAND ATTEN INSERTED
B1-8 & A1-8 | 0dB | C1-8 & C17-24 | 0dB
B1-7 & A1-7 | 0dB | C1-7 & C17-23 | 20dB
B1-6 & A1-6 | 0dB | C1-6 & C17-22 | 40dB
B1-5,A1-5 & B17-21 | 20dB | C1-5 & C17-21 | 40dB
B1-4 & A1-4 | 40dB | C1-4 & C17-20 | 40dB
B1-3 & A1-3 | 60dB | C1-3 & C17-19 | 40dB
B1-2 & A1-2 & B17-18 | CAL | C1-2, C17-18 & C9-10 | 40dB(CAL)
INPUT J2
A4S1A
A4S1B
INPUT IMPEDANCE MATCHING TRANSFORMER A4T1
BROAD BAND INPUT ATTENUATOR
A2S1A
A2S1B
A2R1
A2R3
A2R2
A2C2
A2R4
A2R5
1-KHZ CALIBRATION OSCILLATOR A2A1Q1
TO A1S4C-11&12
A2S1C
+12.7V
BANDWIDTH SELECTOR
A1S1, A1S2, A1S3, A1S5 & A1S6
TERMINAL | BANDWIDTH
1-5 & 7-11 | 250KHZ FIXED WIDE BAND
1-4 & 7-10 | 20 KHZ FIXED WIDE BAND
1-3 & 7-9 | 70 HZ TUNABLE NARROW BAND
1-2 & 7-8 | 7 HZ TUNABLE NARROW BAND
A1S5A
20-KHZ LOW-PASS FILTER A1A1Q1
A1S5B
BROAD BAND LOW-NOISE PREAMPLIFIER A1A1Q5 THRU A1A1Q6
A1S5C
A1R12
A1J13 P1
A1J3 P17 W9 P16 A1J14
NARROW BAND A2S2
WAFER & TERMINAL | ATTENUATION INSERTED (FIRST SECTION) | WAFER & TERMINAL | ATTENUATION INSERTED (SECOND SECTION)
A1-6 & A9-14 | 0dB | B5-10& B13-18 | 0dB
A1-5 & A9-13 | 0dB | B5-9 & B13-17 | 20dB
A1-4 & A9-12 | 0dB | B5-8 & B13-16 | 40dB
A1-3 & A9-11 | 20dB | B5-7 & B13-15 | 40dB
A1-2 & A9-10 | 40dB(CAL) | B5-6 & B13-14 | 40dB(CAL)
NARROW BAND ATTENUATOR (SECOND SECTION)
A2R12
A2R14
A2R13
A2S2B
SECOND I-F AMPLIFIER A1A5Q1 THRU A1A5Q4
MATCHING TRANSFORMER A1A6T1
7-HZ CRYSTAL FILTER A1A6Y1 & A1A6Y2
70-HZ CRYSTAL FILTER A1A6Y3 & A1A6Y4
BUFFER AMPLIFIER A1A6Q1 & A1A6Q2
A1S3A
A1S3B
A1S3C
A1S3D
A1S3E
A1S2A
A1S2B
A1S2C
A1S4A
A1S4B
A1S4C
A1S4D
A1S4E
A1J1 A1J2 A1J3 A1J4 A1J5 P4 A1J6 P5 A1J7 P6 A1J8 P18 W10 P9 A1J9 A1J17 P1
TO SHEET 2
WIDE BAND SECTION
WIDE BAND ATTENUATOR
A2R7
A2R8
A2R5
A2R6
A2S1C
WIDE BAND SIG LEVEL CAL R2
A1J18 P2
WIDE BAND AMPLIFIER A1A1Q1 THRU A1A1Q4
POWER TO TUNABLE LOCAL OSCILLATOR
A1S6A
A1S6B
20-KHZ LOW-PASS FILTER EMITTER FOLLOWER A1A1Q5
250-KHZ LOW-PASS FILTER EMITTER FOLLOWER A1A1Q4
-12.7V
INPUT IMPEDANCE OHMS
A4S1
TERMINALS | INPUT IMPEDANCE
1-2 & 7-8 | 100,000Ω
1-4 & 7-10 | 600Ω
1-4 & 7-12 | 50Ω

Figure 3-2. Model NF-315 Noise and Field Intensity Meter, Detailed Block Diagram (Sheet 1 of 2)

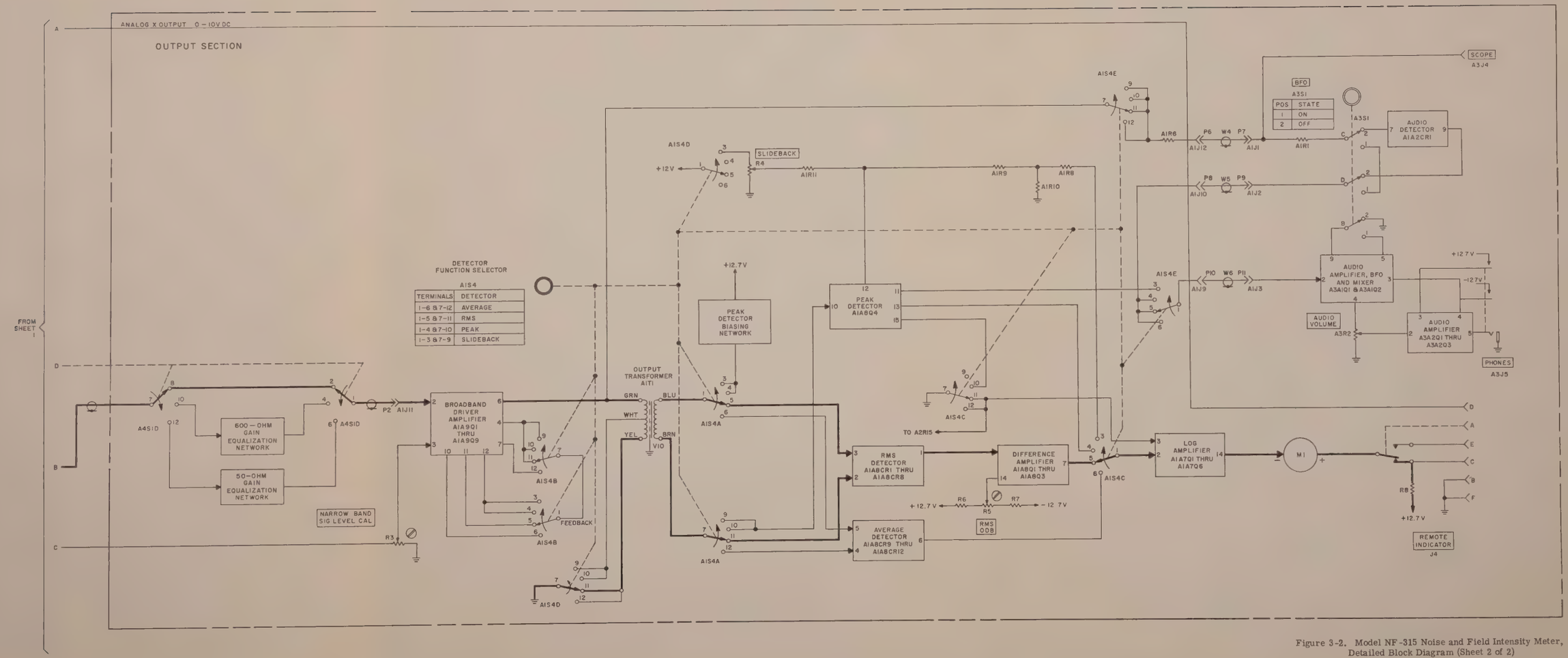


Figure 3-2. Model NF-315 Noise and Field Intensity Meter, Detailed Block Diagram (Sheet 2 of 2)

path is adjustable from 0 to 60 dB in 20-dB steps by the WIDE BAND attenuator switch, and is independent of the operating mode selected. Variable capacitor A2C2 maintains the frequency response of the input attenuator flat over the entire 20 Hz to 250 kHz band by compensating for the inherent and stray capacitance to ground.

3-13. 1-KHZ CALIBRATION OSCILLATOR. When WIDE BAND attenuator switch A2S1 is rotated fully clockwise to obtain a WIDE BAND dB dial indication of CAL, operating power is applied to a 1-kHz (nominal) calibration oscillator (see figure 5-11). The output of exceptionally stable oscillator A2A1Q1, which is set by means of potentiometer A2A1R6, is employed to standardize the gain of the equipment in both the tunable narrow band and fixed wide band modes of operation.

3-14. 20-KHZ LOW-PASS FILTER. When the BANDWIDTH SELECTOR switch is set to 20KHZ FIXED WIDE BAND, 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND, the signal from the broadband input attenuator is routed through wafer A of BANDWIDTH SELECTOR switch A1S5 (one of five switches that are mechanically linked together to functionally serve as one switch) and applied to 20-kHz low-pass filter A1A10A1 (see figure 5-2), a subassembly of 20-kHz low-pass filter and broadband low-noise preamplifier A1A10. The signal is coupled through a 3-dB pad consisting of resistors A1A10A1R1 through A1A10A1R3 and fed to the low-pass filter. The filter, which consists of two m-derived end sections and two constant-k center sections, has a cutoff frequency of 20 kHz. Both the 3-dB pad and the low-pass filter have input impedances of 100,000 ohms. The band limited output of the low-pass filter is coupled through wafer B of BANDWIDTH SELECTOR switch A1S5 and applied to a broadband low-noise preamplifier. When the BANDWIDTH SELECTOR switch is set to 250KHZ FIXED WIDE BAND, the signal from the broadband input attenuator is bypassed around the low-pass filter and applied directly to the low-noise preamplifier.

3-15. BROADBAND LOW-NOISE PREAMPLIFIER. The low-noise preamplifier (see figure 5-2) is the first active stage encountered by the signal under analysis. The primary function of the preamplifier is to amplify low level signal components coupled through the low-pass filter to a level that will permit subsequent frequency conversion when the equipment is operating in the tunable narrow band mode. The preamplifier, which is a broadband low-noise device, employs a field-effect transistor as the input stage (A1A10Q1). The output of A1A10Q1 is d-c coupled through amplifier A1A10Q2 to emitter follower A1A10Q3. The output of the preamplifier is obtained from complementary pair push-pull amplifier A1A10Q4 and A1A10Q5 which operate into a 600-ohm load. The overall gain of the preamplifier is fixed at approximately 23 dB and negative feedback through resistor A1A10R10 provides a wide dynamic range while simultaneously minimizing distortion. The output of the preamplifier is routed through wafer C of BANDWIDTH SELECTOR switch A1S5 to either the wide band attenuator (refer to paragraph 3-18) of the wide band section or the input crystal filter (refer to paragraph 3-21) of the narrow band section, depending on the operating mode selected. Resistor A1A10R12, which is inserted in the input signal path only when the BANDWIDTH SELECTOR switch is set to 250KHZ FIXED WIDE BAND, inserts 3 dB of attenuation in the signal path to make the overall gain of the preamplifier equal to that of the low-pass filter/preamplifier combined.

3-16. DETAILED THEORY OF OPERATION, WIDE BAND SECTION. (See Figures 3-2 and 5-1.)

3-17. WIDE BAND ATTENUATOR. When the BANDWIDTH SELECTOR switch is set to either 250KHZ FIXED WIDE BAND or 20KHZ FIXED WIDE BAND, the output of the broadband low-noise preamplifier is routed through wafer C of A1S5 and applied to a wide band attenuator. The wide band attenuator consists of wafer C of WIDE BAND attenuator switch A2S1 and precision resistors A2R5 through A2R8. Resistors A2R5 and A2R6 form a 20-dB L-section pad while resistors A2R7 and A2R8 form a 40-dB L-section pad. Since both the broadband input attenuator and the wide band attenuator are common to the signal path when the equipment is operating in the fixed wide band mode, a total of 100 dB of attenuation can be inserted into the signal path. The magnitude of the applied signal under measurement (in dB relative to 1 microvolt) is obtained by algebraically adding a dB factor to the output meter dB scale indication. This dB factor, which is a function of both the total attenuation inserted into the signal path and the sensitivity improvement provided by the input impedance matching transformer, is automatically provided to the operator by the WIDE BAND dB dial which is mechanically ganged to both the WIDE BAND attenuator switch and the INPUT IMPEDANCE OHMS switch. The correlation between broadband input attenuation, wide band attenuation, input impedance and meter dB factor is presented in table 3-1.

3-18. WIDE BAND AMPLIFIER. The output of the wide band attenuator is coupled to a wide band amplifier (see figure 5-3) which is operative only when the BANDWIDTH SELECTOR switch is set to either 250KHZ FIXED WIDE BAND or 20KHZ FIXED WIDE BAND. The input signal is coupled through isolation emitter follower A1A11Q1 and d-c coupled to amplifiers A1A11Q2 and A1A11Q3. Degenerative feedback through resistor A1A11R5 sets the overall gain of the wide band amplifier. The output of the wide band amplifier is routed through wafer B of BANDWIDTH SELECTOR switch A1S6, a low-pass filter/emitter follower stage and wafer B of A1S6 to the output section (refer to paragraph 3-26). The overall gain of the wide band amplifier is approximately 34 dB. Fine adjustment of the wide band amplifier gain (when standardizing the gain of the equipment in conjunction with the 1-kHz calibration oscillator) is achieved by WIDE BAND SIG LEVEL CAL screwdriver control R2.

TABLE 3-1. CORRELATION BETWEEN INPUT ATTENUATION, WIDE BAND ATTENUATION, INPUT IMPEDANCE AND WIDE BAND DB DIAL INDICATION (METER DB FACTOR)

WIDE BAND DB DIAL INDICATION (Meter Db Factor)		Input Attenuation Inserted	Wide Band Attenuation Inserted
INPUT IMPEDANCE OHMS Switch Set to 100K	INPUT IMPEDANCE OHMS Switch Set to 600 or 50		
0	-20	0 dB	0 dB
20	0	0 dB	20 dB
40	20	0 dB	40 dB
60	40	20 dB	40 dB
80	60	40 dB	40 dB
100	80	60 dB	40 dB
CAL	CAL	--	40 dB

3-19. DETAILED THEORY OF OPERATION, NARROW BAND SECTION. (See Figures 3-2 and 5-1.)

3-20. TUNABLE LOCAL OSCILLATOR. Tunable local oscillator A5 (see figure 5-10) is a stable, variable-frequency constant-output oscillator which provides the drive for the balanced modulator (refer to paragraph 3-21). A5A1Q1 is a conventional tuned collector oscillator with base feedback. The output frequency of the local oscillator, determined by the capacitance inserted in the collector tank circuit by capacitor A5C1, varies linearly from 100 to 115 kHz with FREQUENCY TUNING control rotation. An analog x-output voltage that varies linearly from 0 to 10 volts as a function of FREQUENCY TUNING control rotation is obtained from the wiper of potentiometer A5R1 and coupled to the REMOTE INDICATOR connector for application to an external x-y plotter. The FREQUENCY TUNING control is mechanically linked to the FREQUENCY 20HZ-15KHZ counter which digitally indicates a frequency 100-kHz below the oscillator output frequency. Trimming of the local oscillator low frequency output is achieved by the FREQUENCY CAL control which adjusts the inductance of A5L3 to provide a 100-kHz output when the FREQUENCY TUNING control is set to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00000. The output of oscillator A5A1Q1 is coupled through buffer amplifier A5A1Q2 and applied to a phase inverter A5A1Q3. Since the output impedance at the collector of A5A1Q3 is greater than that at the emitter, the inverted signal is coupled to emitter follower A5A1Q4, which has the same output impedance as that seen looking into the emitter of the phase inverter. The equal amplitude (but phase inverted) outputs of A5A1Q3 and A5A1Q4 are applied to a push-pull power amplifier consisting of transistors A5A1Q5 and A5A1Q7 and output transformer A5T1. A portion of the output signal, taken at the collector of A5A1Q7, is detected by A5A1CR3 and applied to feedback amplifier A5A1Q6. Feedback amplifier A5A1Q6 adjusts the gain of oscillator A5A1Q1 to maintain an essentially constant amplitude output that is independent of frequency. The output of the tunable local oscillator, which is balanced, is obtained from the secondary of A5T1 and coupled to a four diode bridge modulator.

3-21. INPUT CRYSTAL FILTER AND BALANCED MODULATOR. When the BANDWIDTH SELECTOR switch is set to either 70HZ TUNABLE NARROW BAND or 7HZ TUNABLE NARROW BAND, the band limited output of the broadband low-noise preamplifier is coupled through a 15-kHz low-pass filter (A1L5, A1R13, A1A2R9 and A1A2C6) and applied to a four diode bridge modulator through the primary center tap of balanced modulator output transformer A1A2T1 (see figure 5-4). Although the balanced modulator output transformer is physically mounted on the input crystal filter printed circuit board, it is electrically part of the balanced modulator. The balanced output of the tunable local oscillator is simultaneously applied to the four diode bridge modulator. The modulator, which is a non-linear device, generates the sum and difference frequency components of the applied signal and local oscillator driving voltage. Since the modulator is also a balanced network (balance being achieved by adjustment of split-stator capacitor A1C1 and potentiometer A1R1, in conjunction with the MODULATOR BALANCE controls), the local oscillator drive voltage present in the output is minimized. The secondary of output transformer A1A2T1 is tuned to the 100-kHz difference (intermediate) frequency signal by capacitors A1A2C1 through A1A2C3, thus attenuating unwanted sum frequency modulation products. The 100-kHz i-f signal is coupled through emitter followers A1A2Q3 and A1A2Q4 and routed through wafer A

of BANDWIDTH SELECTOR switch A1S1 to one of two crystal band-pass filters. When the BANDWIDTH SELECTOR switch is set to 7HZ TUNABLE NARROW BAND, the 100-kHz signal is applied to quartz crystals A1A2Y1 and A1A2Y2. The effective tuning of these crystals results in a steep-skirted band-pass filter response having a center frequency of 100 kHz and designed for an overall 3-dB bandwidth of approximately 7 Hz. When the BANDWIDTH SELECTOR switch is set to 70HZ TUNABLE NARROW BAND, crystals A1A2Y3 and A1A2Y4 form a steep-skirted band pass filter designed to provide an overall 3-dB bandwidth of between 50 and 70 Hz. The amplitude response of the 7-Hz filter is adjusted, through a voltage divider network consisting of resistors A1A2R2, A1A2R4 and potentiometer A1A2R3, to equal that of the 70-Hz filter. The output of the selected filter is routed through wafer B of A1S1 to a Darlington output amplifier consisting of A1A2Q1 and A1A2Q2 and applied to the first section of the narrow band attenuator.

3-22. NARROW BAND ATTENUATOR. The narrow band attenuator consists of two sections; the first section located between input crystal filter A1A2 and first i-f amplifier A1A4 and the second section located between first i-f crystal filter A1A3 and second i-f amplifier A1A6. Both the first and second sections of the narrow band attenuator have input impedances of 5,000 ohms. The first section, which consists of wafer A of NARROW BAND attenuator switch A2S2 and precision resistors A2R9 through A2R11, forms a tapped L-section pad providing either 20 or 40 dB of attenuation, as determined by the setting of A2S2. The second section, consisting of wafer B of A2S2 and precision resistors A2R12 through A2R14, is also a tapped L-section pad and, like the first section, inserts either 20 or 40 dB of attenuation in the signal line. Since both sections of the narrow band attenuator and the broadband input attenuator are common to the signal path when the equipment is operating in the tunable narrow band mode, a total of 140 dB of attenuation can be inserted into the signal path. The magnitude of the applied signal frequency component (in dB relative to 1 microvolt) is obtained by algebraically adding a dB factor to the output meter dB scale indication. This dB factor is a function of both the total attenuation (input and narrow band) inserted into the signal path and the sensitivity improvement provided by the input impedance matching transformer. The correlation between the broadband input attenuation, narrow band attenuation, input impedance and meter dB factor is presented in table 3-2. This dB factor is automatically provided to the operator through the mechanical linkage that exists between the WIDE BAND attenuator switch, the NARROW BAND attenuator switch, the INPUT IMPEDANCE OHMS switch and the NARROW BAND dB dial.

3-23. 100-KHZ I-F AMPLIFIERS. I-f amplifiers A1A4 and A1A6 are identical circuits (see figure 5-5.) The operation of amplifier A1A4 is presented in the following discussion and the equivalent information concerning amplifier A1A6 is referenced in parenthesis. The 100-kHz signal applied to the i-f amplifier is coupled through impedance matching emitter follower A1A4Q1 (A1A6Q1) and applied to broadly tuned amplifier A1A4Q2 (A1A6Q2). After two additional stages of tuned amplification, the 100-kHz signal is applied to the following stage, i-f crystal filter A1A3 (A1A5). Gain adjustment of the i-f amplifier, to compensate for the difference in insertion loss between the 70- and 7-Hz crystal filters, is accomplished by shunting emitter resistor A1A4R12 (A1A6R12) with resistor A1A4R13 (A1A6R13) through wafer B of BANDWIDTH SELECTOR switch A1S2 (A1S3). The overall gain of the i-f amplifier, including the following crystal filter stage, is approximately 40 dB.

3-24. I-F CRYSTAL FILTERS. Crystal filters A1A3 and A1A5 are identical circuits (see figure 5-6). The operation of crystal filter A1A3 is presented in the following discussion and the equivalent information concerning crystal filter A1A5 is referenced in parenthesis. The 100-kHz output of i-f amplifier A1A4 (A1A6) is applied to matching transformer A1A3T1 (A1A5T1), the secondary of the transformer being broadly tuned to 100 kHz by capacitors A1A3C2 through A1A3C4 (A1A5C2 through A1A5C4). The signal is then routed through wafer A of BANDWIDTH SELECTOR switch A1S2 (A1S3) and applied to one of two crystal band-pass filters. These filters operate in the same fashion as those described in paragraph 3-21. The output of the selected filter is coupled to the output section through wafer B of BANDWIDTH SELECTOR switch A1S6.

3-25. DETAILED THEORY OF OPERATION, OUTPUT SECTION. (See Figures 3-2 and 5-1.)

3-26. GAIN EQUALIZATION NETWORK. As discussed in paragraph 3-11, the input impedance matching transformer provides signal sensitivity improvements of approximately 22 and 37 dB when the INPUT IMPEDANCE OHMS switch is set to 600 or 50, respectively, compared to that for the 100,000-ohm input impedance. To fix the sensitivity improvement between the 100,000-ohm input impedance and both the 600- and 50-ohm input impedances at 20 dB, attenuation must be inserted in the signal path when the INPUT IMPEDANCE OHMS switch is set to either 600 or 50. Thus, when A4S1 is set to 600, resistor A4R6, in conjunction with potentiometer A4R7, inserts approximately 2 dB of attenuation in the signal path to make the overall sensitivity improvement 20 dB. Similarly, when the INPUT IMPEDANCE OHMS switch is set to 50, resistor A4R4, in conjunction with potentiometer A4R5, inserts approximately 17 dB of attenuation into the signal path to make the overall sensitivity improvement 20 dB. The equalized output is then coupled through wafer D of A4S1 to the driver amplifier.

3-27. BROADBAND DRIVER AMPLIFIER. The driver amplifier (see figure 5-7) is a broadband power amplifier whose function is to drive any one of the subsequent detector stages. The applied signal is coupled through emitter follower A1A9Q1 and fed to the base of amplifier A1A9Q2. When the equipment is operating in the fixed wide band mode, amplifier A1A9Q2 operates as a fixed gain stage.

TABLE 3-2. CORRELATION BETWEEN INPUT ATTENUATION, NARROW BAND ATTENUATION, INPUT IMPEDANCE, WIDE BAND DB DIAL INDICATION AND NARROW BAND DB DIAL INDICATION (METER DB FACTOR)

WIDE BAND dB Dial Indication		NARROW BAND dB Dial Indication (Meter dB Factor)		Input Attenuation Inserted	Narrow Band Attenuation (First Section) Inserted	Narrow Band Attenuation (Second Section) Inserted
INPUT IMPEDANCE OHMS Switch Set to 100K	INPUT IMPEDANCE OHMS Switch Set to 600 or 50	INPUT IMPEDANCE OHMS Switch Set to 100K	INPUT IMPEDANCE OHMS Switch Set to 600 or 50			
0, 20 or 40	-20, 0 or 20	-40	-60	0 dB	0 dB	0 dB
		-20	-40		0 dB	20 dB
		0	-20		0 dB	40 dB
		20	0		20 dB	40 dB
		40	20		40 dB	40 dB
60	40	-20	-40	20 dB	0 dB	0 dB
		0	-20		0 dB	20 dB
		20	0		0 dB	40 dB
		40	20		20 dB	40 dB
		60	40		40 dB	40 dB
80	60	0	-20	40 dB	0 dB	0 dB
		20	0		0 dB	20 dB
		40	20		0 dB	40 dB
		60	40		20 dB	40 dB
		80	60		40 dB	40 dB
100	80	20	0	60 dB	0 dB	0 dB
		40	20		0 dB	20 dB
		60	40		0 dB	40 dB
		80	60		20 dB	40 dB
		100	80		40 dB	40 dB
CAL	CAL	40	20	--	0 dB	0 dB
		60	40		0 dB	20 dB
		80	60		0 dB	40 dB
		100	80		20 dB	40 dB
		CAL	CAL		40 dB	40 dB

When the tunable narrow band operating mode is selected, the gain of A1A9Q2 is adjusted, by varying the dynamic resistance of diode A1A9CR1 through NARROW BAND SIG LEVEL CAL screwdriver control R3, to permit gain standardization. The signal is then applied to a stable temperature compensated feedback amplifier (A1A9Q3 through A1A9Q9) which, in conjunction with wafer B of Detector function selector switch A1S4, modifies the output level to drive the selected detector (refer to paragraphs 3-28 through 3-30).

3-28. AVERAGE DETECTOR. When Detector function selector switch A1S4 is set to AVERAGE, the output of the broadband driver amplifier is routed through wafer A and applied to a full-wave bridge rectifier consisting of diodes A1A8CR9 through A1A8CR12 (see figure 5-8). The output of the rectifier is filtered and the resultant d-c level, which is proportional to the average value (0.636 x sine wave peak), is coupled through wafer C of A1S4 and applied to the log amplifier (refer to paragraph 3-31).

3-29. RMS DETECTOR. When the Detector function selector switch is set to RMS, the broadband driver amplifier output is applied to a full-wave bridge rectifier consisting of diodes A1A8CR1 through A1A8CR8 (see figure 5-8). These diodes exhibit square-law characteristics for low level applied signals, thereby providing a d-c output voltage that is proportional to the rms value of the applied signal. The low level output is coupled through a balanced temperature compensated d-c amplifier which increases the signal level to that value required to drive the log amplifier. Balance is accomplished by means of RMS ODB screwdriver control R5 in conjunction with RMS ODB PRESS toggle switch S2. When the equipment is operating in the fixed wide band mode and the WIDE BAND attenuator switch is rotated fully clockwise to activate the 1-kHz calibration oscillator, depressing RMS ODB PRESS toggle switch S2 shunts potentiometer A2R15 across the calibration oscillator output, providing a reference voltage that is employed to balance and calibrate the d-c amplifier. Balance is achieved by adjusting RMS ODB screwdriver control R5 until a meter indication of SET is obtained on the RMS scale.

3-30. PEAK DETECTOR. When the Detector function selector switch is set to PEAK, the output of the broadband driver amplifier is coupled through the base-emitter junction of A1A8Q4 (see figure 5-8) and the rectified output applied to capacitor A1A8C4 and resistors A1A8R17 and A1A8R18. The output of the peak detector, which is proportional to the maximum amplitude of the applied signal, is then applied to the log amplifier. When the Detector function selector switch is set to SLIDEBACK, capacitor A1A8C4 is removed from the emitter circuit of A1A8Q4 and the stage functions as an emitter follower. A back-biasing voltage obtained from SLIDEBACK potentiometer R4 is applied to the emitter of A1A8Q4 through decoupling diode A1A8CR14. The magnitude of the applied back-bias voltage is adjusted until the emitter voltage is equal to the signal voltage present at the base, thereby cutting off the stage. The actual value of the back-bias voltage, which is proportional to the peak value of the signal being evaluated, is coupled to the log amplifier. The slideback technique is used when the equipment operating in the tunable narrow band mode.

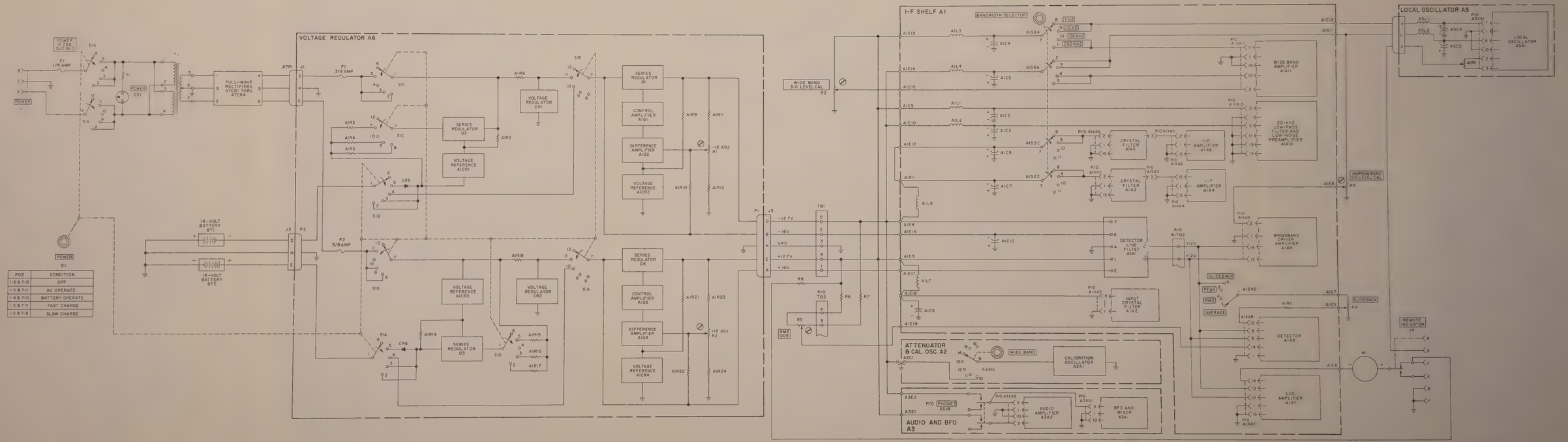
3-31. LOG AMPLIFIER. The d-c output from the selected detector is routed through wafer C of A1S4 and applied to a two-decade log amplifier (see figure 5-9). The first section of the log amplifier is an operational amplifier (A1A7Q1 through A1A7Q4) that employs a diode as a logarithmic feedback element. The non-linear feedback introduced by the diode causes the amplifier output to be a logarithmic function of the input. The output of the amplifier is coupled through emitter follower A1A7Q5 and applied to the emitter of A1A7Q6, which functions as a current source to drive the front panel meter. Since the log amplifier output current is a logarithmic function of the applied signal voltage, the meter scales are linearly calibrated in dB. The actual value of the applied signal strength can be quickly evaluated by simply adding the figure within the WIDE BAND or NARROW BAND dB dial window (depending on the operating mode selected) to the meter dB scale indication. Calibration curves are provided to obtain optimum measurement accuracy for the particular bandwidth and detector function selected.

3-32. AUDIO AND BEAT FREQUENCY CIRCUITS. The output of the broadband driver amplifier, in addition to being applied to the selected detector, is also coupled simultaneously to SCOPE connector A3J4 and the wiper of BFO switch A3S2C. When the BFO switch is set to ON with the equipment operating in the tunable narrow band mode (to facilitate the reception of low level signals or the measurement of the peak value of low duty cycle applied signals by the slideback technique), the 100-kHz output of the driver amplifier is routed through A3S2D and applied to the base of audio amplifier/mixer A3A1Q2 (see figure 5-12). A 100.600-kHz output from crystal-controlled oscillator A3A1Q1 is simultaneously applied to the emitter of A3A1Q2. The sum and difference frequency mixing products are coupled through AUDIO VOLUME control A3R2 and applied to audio amplifiers A3A2Q1 through A3A2Q3 (see figure 5-13). The low frequency response of the audio amplifier passes only the 600-Hz difference frequency to the PHONES connector for application to an external 600-ohm headset. When the BFO switch is set to OFF, the applied signal components that fall within the audio range are coupled through audio amplifiers A3A1Q2 and A3A2Q1 through A3A2Q3 and applied to PHONES connector A3J5. Note that the audio and beat frequency circuits are operative only when a headset is plugged into the PHONES connector.

3-33. DETAILED THEORY OF OPERATION, POWER SUPPLIES. (See Figure 3-3.)

3-34. Operating power for the Model NF-315 is obtained from a conventional voltage regulator which draws power from a 115- or 230-volt a-c line or self-contained nickel-cadmium batteries. When POWER SELECTOR switch S1 is set to AC OPERATE,

the applied line voltage is stepped down by power transformer T1 and applied to two full wave rectifiers (A7CR1 through A7CR4) which, after filtering, provide unregulated outputs of +30 and -30 volts. These voltages are coupled to two conventional voltage regulators (A6Q1, A6Q4 and A6A1Q1 through A6A1Q4) which provide regulated outputs of ±12.7 and ±16 volts. Regulated ±12 volts are provided by series regulators A1A1Q1 and A1A1Q2. During a-c operation a trickle charge is applied to the two self-contained batteries through charging regulators A6Q2 and A6Q3. When the POWER SELECTOR switch is set to either FAST CHARGE or SLOW CHARGE, the output of the full wave rectifiers is coupled only to the charging voltage regulator. The rate of battery charge is determined by the value of the resistor inserted in the emitter circuit of the voltage regulator. Blocking diodes A6CR5 and A6CR6 are inserted in the charging circuit paths to prevent discharging of the batteries through the voltage regulators should line power be inadvertently removed from the equipment while the POWER SELECTOR switch is set to AC OPERATE. When the POWER SELECTOR switch is set to BATTERY OPERATE, the self-contained batteries drive the voltage regulators.



POS	CONDITION
1-5 & 7-12	OFF
1-5 & 7-11	AC OPERATE
1-4 & 7-10	BATTERY OPERATE
1-3 & 7-9	FAST CHARGE
1-2 & 7-8	SLOW CHARGE

Figure 3-3. Power Distribution Diagram

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance, alignment and calibration instructions for the Model NF-315 Noise and Field Intensity Meter. Included are a list of test equipment necessary to maintain the equipment, minimum performance standards checks to evaluate whether the equipment operates within published specifications, systematic troubleshooting procedures to localize a malfunction to an individual subassembly or circuit and alignment and calibration procedures necessary to restore the equipment to proper operating condition after the required repairs have been effected.

4-3. TEST EQUIPMENT REQUIRED.

4-4. The test equipment required for the maintenance and calibration of the Model NF-315 is listed in table 4-1. Equipment having similar characteristics may be substituted for those listed in the table.

4-5. MINIMUM PERFORMANCE STANDARDS CHECKS.

4-6. The minimum performance standards checks is an aid to evaluate whether the Model NF-315 is functioning within the specifications listed in Section I. Should the Model NF-315 fail to provide the "normal indication" specified, the equipment is not operating properly and the operator should refer to the applicable troubleshooting, replacement, repair, alignment and/or calibration procedure to return the equipment to normal operating condition. Set the front panel controls as listed in table 4-2 prior to initiating the minimum performance standards checks detailed in table 4-3.

4-7. COMPONENT LOCATIONS.

4-8. The location of major assemblies and subassemblies are illustrated in figures 4-2 through 4-4.

TABLE 4-1. TEST EQUIPMENT REQUIRED

Manufacturer	Model
Simpson	Model 260 Multimeter
Power Designs	Model 1515 Power Supply
Hewlett-Packard	Model 200CD oscillator
The Singer Company	Model EA-315 Earphones
Hewlett-Packard	Model 5532A Electronic Counter
Tektronix	Model 503 Oscilloscope
The Singer Company	Model RE-315 Remote Indicator
The Singer Company	Model RC-315 Remote Indicator Cable
The Singer Company	Model CB-6-315 Antenna Cable
Hewlett-Packard	Model 3440A Digital Vtvm with Model 3443A Plug-in
General Radio	Type W5MT3A Autotransformer
Pomona	Model MDP-R 600-Ohm Resistor
Pomona	Model 2BC-36 Cable (2 required)

TABLE 4-1. TEST EQUIPMENT REQUIRED (Cont'd)

Manufacturer	Model
Hewlett-Packard	Model 400H Vtvm (2 required)
Pomona	Model 1367-C-36 Cable
Pomona	Model 1269 Adapter
Pomona	Model 1651-1 Matching Pad
Pomona	Model MDP Connector
Freed	Model LLP-1500 Low-pass Filter (2 required)
Hewlett-Packard	Model 350D Attenuator
- - - - -	Type UG-274/U Adapter (2 required)
- - - - -	1, 500-Ohm, 1/2-watt, 5% Resistor
Pomona	Model 2BC-BNC-36 Cable (2 required)
Digitec	Model Z-200B Digital Vtvm

TABLE 4-2. PRELIMINARY CONTROL SETTINGS FOR MINIMUM PERFORMANCE STANDARDS CHECKS

Control	Setting
POWER selector switch	OFF
INPUT IMPEDANCE OHMS switch	100K
BANDWIDTH SELECTOR switch	250KHZ FIXED WIDE BAND
Detector function selector switch	AVERAGE
WIDE BAND attenuator switch	To obtain WIDE BAND dB dial indication of 100
NARROW BAND attenuator switch	To obtain NARROW BAND dB dial indication of 100
BFO switch	OFF
SLIDEBACK control	Fully clockwise
AUDIO VOLUME control	Mid-position

4-9. POWER SUPPLY CHECK.

4-10. Improper operation of the Model NF-315 may be due to a malfunction within the power supply. To ascertain that the required voltages are being developed, proceed as directed in the following steps.

a. Remove the Model NF-315 from its case as described in paragraph 2-6.

b. Couple the Model NF-315 to line power as described in paragraphs 2-28 and 2-29.

c. Measure the voltages present between the points specified in table 4-4. (See figures 4-2 and 4-4 for the location of terminal boards A1TB2 and TB1.) If the designated "Normal Indication" is not obtained, refer to paragraph 4-11.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS

Step	Purpose	Procedure	Acceptable Indication
1	To evaluate mechanical zero set of front panel meter and remote indicator meters.	With the Model NF-315 removed from line power and the POWER selector switch set to OFF, observe the pointer indication on both the front panel meter and the remote indicator meter; the pointers should rest at the hash mark directly to the left of the AVG scale 0 DB mark. Adjust the meter mechanical zero screw, if necessary, to obtain the proper pointer indication.	Pointer of both the front panel meter and the remote indicator meter rest at the hash mark directly to the left of the AVG scale 0 DB mark.
2	To evaluate operation of calibration oscillator.	With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Couple an oscilloscope directly to the SCOPE connector (see figure 4-1) and observe the waveform displayed.	Oscilloscope displays a nominal 1-kHz (600 to 1400 Hz) slightly distorted sinusoidal waveform.
3	To evaluate calibration curve accuracy (frequency response) when operating in the 250-kHz fixed wide band mode in conjunction with the 100,000-ohm input impedance.	Terminate the signal generator with a 600-ohm resistor, as shown in figure 4-1, and adjust the signal generator for minimum output level at 1 kHz. With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm). Note the meter AVG scale indication.	Meter indicates within ±1.1 dB of CAL on AVG scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±0.5 dB of CAL mark at each frequency.

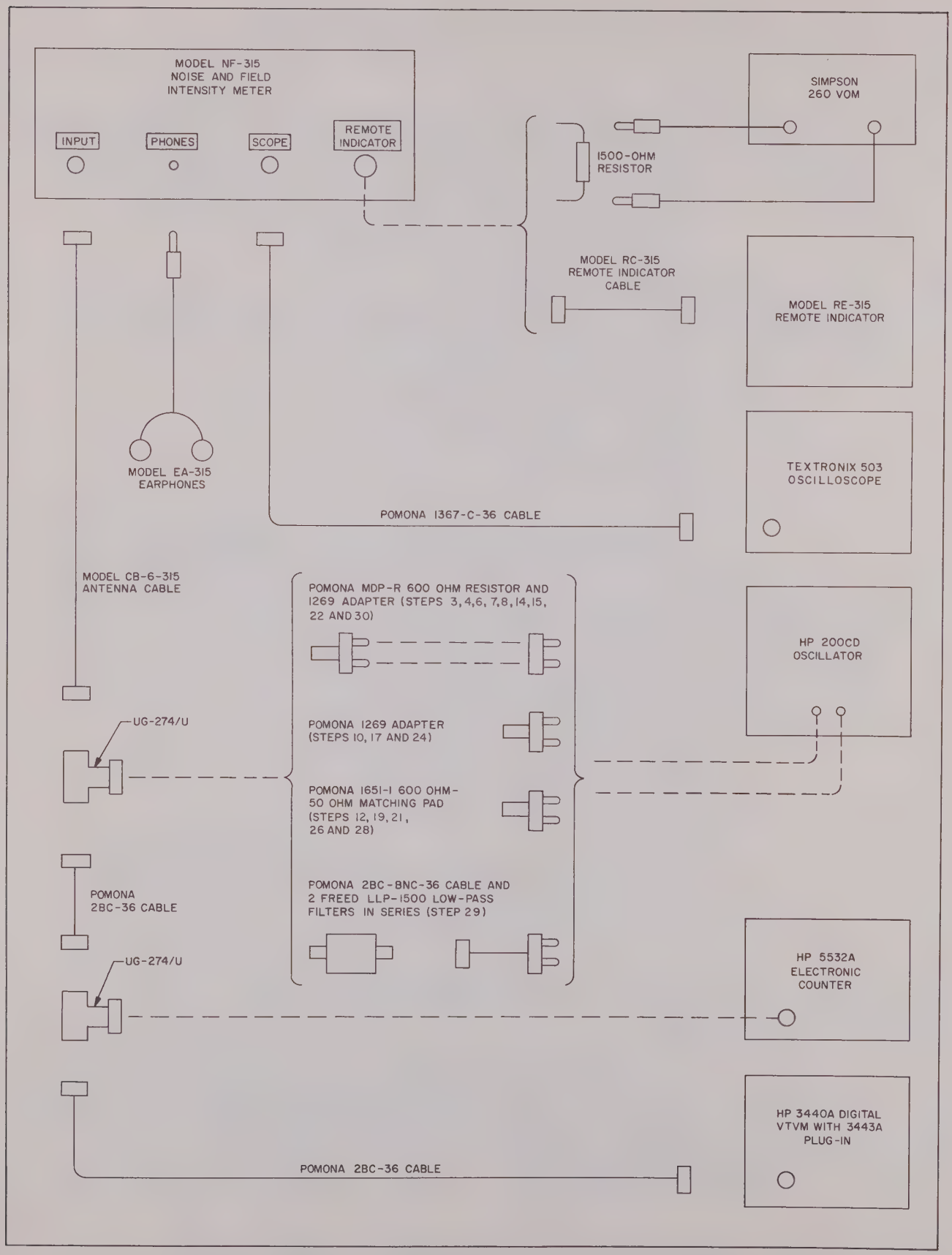


Figure 4-1. Test Setup for Minimum Performance Standards Checks

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
3 (cont)		Frequencies: 20 Hz, 100 Hz, 10 kHz, 100 kHz, 200 kHz and 250 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the Detector function selector switch to RMS and depress the RMS O DB PRESS toggle switch. While the RMS O DB PRESS toggle switch is depressed, adjust the RMS O DB screwdriver control, if necessary, to obtain a meter RMS scale indication of SET. Release the RMS O DB PRESS toggle switch.	Meter indicates SET on RMS scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 316 millivolt rms output (as determined by the digital vtvm). Note the meter RMS scale indication.	Meter indicates within ±0.9 DB of 10 DB on RMS scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter RMS scale indication of exactly 10 DB.	Meter indicates 10 DB on RMS scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 316 millivolt rms output (as determined by the digital vtvm) and note the meter RMS scale indication. Frequencies: 20 Hz, 100 Hz, 10 kHz, 100 kHz, 200 kHz and 250 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter RMS scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±0.6 dB of 10 DB mark at each frequency.
		Set the Detector function selector switch to PEAK and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of CAL.	Meter indicates CAL on PEAK scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
3 (cont)		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 3.535 volt rms output (as determined by the digital vtvm). Note the meter PEAK scale indication.	Meter indicates within ±0.9 dB of CAL on PEAK scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of CAL.	Meter indicates CAL on PEAK scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 3.535 volt rms output (as determined by the digital vtvm) and note the meter PEAK scale indication. Frequencies: 20 Hz, 100 Hz, 10 kHz, 100 kHz, 200 kHz and 250 kHz	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±0.6 dB of CAL mark at each frequency.
		Tune the signal generator to 1 kHz and adjust for minimum output level.	
4	To evaluate scale tracking accuracy of average detector function in the 250-kHz fixed wide band mode in conjunction with the 100,000-ohm input impedance.	With the equipment connected as shown in figure 4-1 and the signal generator terminated with a 600-ohm resistor, adjust the signal generator for minimum output level at 1 kHz. With the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND and the INPUT IMPEDANCE OHMS switch set to 100K, set the Detector function selector switch to AVERAGE and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 1.11 volt rms output (as determined by the digital vtvm). Note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±1.6 dB of 40 DB mark.
		Note the oscilloscope display.	Oscilloscope display is a compressed representation of a sinusoidal signal.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
4 (cont)		Adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±1.1 dB of CAL mark.
		Adjust the signal generator for a 1.11 volt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±1.6 dB of 20 DB mark.
		Adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±2.1 dB of 10 DB mark.
		Adjust the signal generator for a 111 millivolt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±2.6 dB of 0 DB mark.
		Adjust the signal generator for a minimum output level.	
5	To evaluate sensitivity of average detector function in the 250-kHz fixed wide band mode in conjunction with the 100,000-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector.	
		With the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND and the INPUT IMPEDANCE OHMS switch set to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 0 and note the meter AVG scale indication.	Meter indicates 23 dB or less on AVG scale.
		Note the oscilloscope display.	Oscilloscope displays random noise.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.	

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
6	To evaluate scale tracking accuracy of rms detector function in the 250-kHz fixed wide band mode in conjunction with the 100,000-ohm input impedance.	With the equipment connected as shown in figure 4-1 and the signal generator terminated with a 600-ohm resistor, adjust the signal generator for minimum output level at 1 kHz.	
		With the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND and the INPUT IMPEDANCE OHMS switch set to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the Detector function selector switch to RMS and depress the RMS 0 DB PRESS toggle switch. While the RMS 0 DB PRESS toggle switch is depressed, adjust the RMS 0 DB screwdriver control, if necessary, to obtain a meter RMS scale indication of SET.	Meter indicates SET on RMS scale.
		Release the RMS 0 DB PRESS toggle switch.	
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 1.00 volt rms output (as determined by the digital vtvm). Note the meter RMS scale indication.	Meter RMS scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±2.0 dB of 20 DB mark.
		Adjust the signal generator for a 316 millivolt rms output (as determined by the digital vtvm) and note the meter RMS scale indication.	Meter RMS scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±1.5 dB of 10 DB mark.
		Adjust the signal generator for a 100 millivolt rms output (as determined by the digital vtvm) and note the meter RMS scale indication.	Meter RMS scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±2.0 db of 0 DB mark.
		Adjust the signal generator for minimum output level.	
7	To evaluate scale tracking accuracy of peak detector function in the 250-kHz fixed wide band mode in conjunction with the 100,000-ohm input impedance.	With the equipment connected as shown in figure 4-1 and the signal generator terminated with a 600-ohm resistor, adjust the signal generator for minimum output level at 1 kHz.	

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
7 (cont)		With the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND and the INPUT IMPEDANCE OHMS switch set to 100K, set the Detector function selector switch to PEAK and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of CAL.	Meter indicates CAL on PEAK scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 7.07 volt rms output (as determined by the digital vtvm). Note the meter PEAK scale indication.	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±1.8 dB of 40 DB mark.
		Adjust the signal generator for a 2.21 volt rms output (as determined by the digital vtvm) and note the meter PEAK scale indication.	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±1.7 dB of 30 DB mark.
		Adjust the signal generator for a 707 millivolt rms output (as determined by the digital vtvm) and note the meter PEAK scale indication.	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±2.2 dB of 20 DB mark.
		Adjust the signal generator for a 221 millivolt rms output (as determined by the digital vtvm) and note the meter PEAK scale indication.	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-5a) is within ±2.7 dB of 10 DB mark.
		Adjust the signal generator for minimum output level.	
8	To evaluate calibration curve accuracy (frequency response) when operating in the 20-kHz fixed wide band mode in conjunction with the 100,000-ohm input impedance.	With the equipment connected as shown in figure 4-1 and the signal generator terminated with a 600-ohm resistor, adjust the signal generator for minimum output level at 1 kHz.	
		With the INPUT IMPEDANCE OHMS switch set to 100K, set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, is necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
8 (cont)		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm). Note the meter AVG scale indication.	Meter indicates within ±0.6 dB of CAL on AVG scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm) and note the meter AVG scale indication. Frequencies: 20 Hz, 100 Hz, 5kHz, 10 kHz, 15 kHz and 20 kHz	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5b) is within ±0.5 dB of CAL mark.
		Tune the signal generator to 1 kHz and adjust for minimum output level.	
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the Detector function selector switch to RMS and depress the RMS 0 DB PRESS toggle switch. While the RMS 0 DB PRESS toggle switch is depressed, adjust the RMS 0 DB screwdriver control, if necessary, to obtain a meter RMS scale indication of SET.	Meter indicates SET on RMS scale.
		Release the RMS 0 DB PRESS toggle switch.	
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 316 millivolt rms output (as determined by the digital vtvm). Note the meter RMS scale indication.	Meter indicates within ±0.8 dB of 10 DB on RMS scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter RMS scale indication of exactly 10 DB.	Meter indicates 10 DB on RMS scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
8 (cont)		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 316 millivolt rms output (as determined by the digital vtvm) and note the meter RMS scale indication. Frequencies: 20 Hz, 100 Hz, 5kHz, 10 kHz, 15 kHz and 20 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter RMS scale indication (plus calibration curve correction factor - see figure 2-5b) is within ±0.5 dB of 10 DB mark at each frequency.
		Set the Detector function selector switch to PEAK and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of CAL.	Meter indicates CAL on PEAK scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the signal generator for a 3.535 volt rms output (as determined by the digital vtvm). Note the meter PEAK scale indication.	Meter indicates within ±1.0 dB of CAL on PEAK scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of exactly CAL.	Meter indicates CAL on PEAK scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 3.535 volt rms output (as determined by the digital vtvm) and note the meter PEAK scale indication. Frequencies: 20 Hz, 100 Hz, 5 kHz, 10 kHz, 15 kHz and 20 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-5b) is within ±0.5 dB of CAL mark at each frequency.
9	To evaluate sensitivity of average detector function in the 20-kHz fixed wide band mode in conjunction with the 100,000-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector.	

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
9 (cont)		With the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND and the INPUT IMPEDANCE OHMS switch set to 100K, set the Detector function selector switch to AVERAGE and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 0 and note the meter AVG scale indication.	Meter indicates 20 dB or less on AVG scale.
		Note the oscilloscope display.	Oscilloscope displays random noise.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.	
10	To evaluate calibration curve accuracy (frequency response) when operating in the 20-kHz fixed wide band mode in conjunction with the 600-ohm input impedance.	With the signal generator coupled directly to the INPUT connector as shown in figure 4-1, adjust the signal generator for minimum output level at 1 kHz.	
		With the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND and the INPUT IMPEDANCE OHMS switch set to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm). Note the meter AVG scale indication.	Meter indicates within ±0.7 dB of CAL on AVG scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
10 (cont)		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm) and note the meter AVG scale indication. Frequencies: 20 Hz, 100 Hz, 5kHz, 10 kHz, 15 kHz and 20 kHz	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-6a) is within ±0.5 dB of CAL mark at each frequency.
		Tune the signal generator to 1 kHz and adjust for minimum output level.	
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the INPUT IMPEDANCE OHMS switch to 100K and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the Detector function selector switch to RMS and depress the RMS 0 DB PRESS toggle switch. While the RMS 0 DB PRESS toggle switch is depressed, adjust the RMS 0 DB screwdriver control, if necessary, to obtain a meter RMS scale indication of SET.	Meter indicates SET on RMS scale.
		Release the RMS 0 DB PRESS toggle switch.	
		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and adjust the signal generator for a 31.6 millivolt rms output (as determined by the digital vtvm). Note the meter RMS scale indication.	Meter indicates within ±0.9 dB of 10 DB on RMS scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter RMS scale indication of exactly 10 DB.	Meter indicates 10 DB on RMS scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 31.6 millivolt rms output (as determined by the digital vtvm) and note the meter RMS scale indication.	Meter RMS scale indication (plus calibration curve correction factor - see figure 2-6a) is within ±0.5 dB of 10 DB mark at each frequency.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
10 (cont)		Frequencies: 20 Hz, 100 Hz, 5 kHz, 10 kHz, 15 kHz and 20 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	
		Set the Detector function selector switch to PEAK, set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, is necessary, to obtain a meter PEAK scale indication of CAL.	Meter indicates CAL on PEAK scale.
		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and adjust the signal generator for a 353.5 millivolt rms output (as determined by the digital vtvm). Note the meter PEAK scale indication.	Meter indicates within ±1.0 dB of CAL on PEAK scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of exactly CAL.	Meter indicates CAL on PEAK scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 353.5 millivolt rms output (as determined by the digital vtvm) and note the meter PEAK scale indication. Frequencies: 20 Hz, 100 Hz, 5 kHz, 10 kHz, 15 kHz and 20 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-6a) is within ±0.6 dB of CAL mark at each frequency.
11	To evaluate sensitivity of average detector function in the 20-kHz fixed wide band mode in conjunction with the 600-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector. With the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, the INPUT IMPEDANCE OHMS switch set to 100K, set the Detector function selector switch to AVERAGE and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
11 (cont)		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of -20 and note the meter AVG scale indication.	Meter indicates 20 dB or less on AVG scale.
		Note the oscilloscope display.	Oscilloscope displays random noise.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80.	
12	To evaluate calibration curve accuracy when operating in the 20-kHz fixed wide band mode in conjunction with the 50-ohm input impedance.	With the signal generator coupled to the INPUT connector through a 600- to 50-ohm matching pad as shown in figure 4-1, adjust the signal generator for minimum output level at 1 kHz.	
		With the Detector function selector switch set to AVERAGE and the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, set the INPUT IMPEDANCE OHMS switch to 100K and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 50 and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80. Adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter indicates within ±0.8 dB of CAL on AVG scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm) and note the meter AVG scale indication. Frequencies: 20 Hz, 100 Hz, 5 kHz, 10 kHz, 15 kHz and 20 kHz	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-7a) is within ±0.5 dB of CAL mark at each frequency.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
12 (cont)		Tune the signal generator to 1 kHz and adjust for minimum output level.	
		Set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the Detector function selector switch to RMS and depress the RMS 0 DB PRESS toggle switch. While the RMS 0 DB PRESS toggle switch is depressed, adjust the RMS 0 DB screwdriver control, if necessary, to obtain a meter RMS scale indication of SET.	Meter indicates SET on RMS scale.
		Release the RMS 0 DB PRESS toggle switch.	
		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and adjust the signal generator for a 31.6 millivolt rms output (as determined by the digital vtvm). Note the meter RMS scale indication.	Meter indicates within ±1.0 dB of 10 DB on RMS scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter RMS scale indication of exactly 10 DB.	Meter indicates 10 DB on RMS scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 31.6 millivolt rms output (as determined by the digital vtvm) and note the meter RMS scale indication. Frequencies: 20 Hz, 100 Hz, 5 kHz, 10 kHz, 15 kHz and 20 kHz	Meter RMS scale indication (plus calibration curve correction factor - see figure 2-7a) is within ±0.5 dB of 10 DB mark at each frequency.
		Tune the signal generator to 1 kHz and adjust for minimum output level.	
		Set the Detector function selector switch to PEAK, set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of CAL.	Meter indicates CAL on PEAK scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
12 (cont)		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and adjust the signal generator for a 353.5 millivolt rms output (as determined by the digital vtvm). Note the meter PEAK scale indication.	Meter indicates within ±0.9 dB of CAL on PEAK scale.
		Adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of exactly CAL.	Meter indicates CAL on PEAK scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 353.5 millivolt rms output (as determined by the digital vtvm) and note the meter PEAK scale indication. Frequencies: 20 Hz, 100 Hz, 5 kHz, 10 kHz, 15 kHz and 20 kHz	Meter PEAK scale indication (plus calibration curve correction factor - see figure 2-7a) is within ±0.5 dB of CAL mark at each frequency.
		Tune the signal generator to 1 kHz and adjust for minimum output level.	
13	To evaluate sensitivity of average detector function in the 20-kHz fixed wide band mode in conjunction with the 50-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector.	
		With the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, set the Detector function selector switch to AVERAGE, set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the WIDE BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of -20 and note the meter AVG scale indication.	Meter indicates 12 dB or less on AVG scale.
		Note the oscilloscope display.	Oscilloscope displays random noise.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80.	
14	To evaluate calibration curve accuracy (frequency response) when operating in the 70-Hz tunable narrow band mode in conjunction with the 100,000-ohm input impedance.	With the equipment connected as shown in figure 4-1 and the signal generator terminated with a 600-ohm resistor, adjust the signal generator for minimum output level at 1 kHz.	

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
14 (cont)		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL and adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection.	Meter pointer deflects to a maximum indication when FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 (the NARROW BAND dB dial will now read 100) and adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm). Adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication.	Meter indicates within ±0.5 dB of CAL on AVG scale.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm), adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication. Frequencies: 22 Hz, 100 Hz, 500 Hz, 3 kHz, 5 kHz, 7 kHz, 11 kHz, 13 kHz and 15 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5c) is within ±0.5 dB of CAL mark at each frequency.
15	To evaluate scale tracking accuracy of average detector function in the 70-Hz tunable narrow band mode in conjunction with the 100,000-ohm input impedance.	With the equipment connected as shown in figure 4-1 and the signal generator terminated with a 600-ohm resistor, adjust the signal generator for minimum output level at 1 kHz.	

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
15 (cont)		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL and adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection.	Meter pointer deflects to a maximum indication when FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 (the NARROW BAND dB dial will now read 100), adjust the signal generator for an 11.1 volt rms output (as determined by the digital vtvm), adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5c) is within ±1.5 dB of 40 DB mark.
		Adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5c) is within ±1.0 dB of CAL mark.
		Adjust the signal generator for a 1.11 volt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5c) is within ±1.5 dB of 20 DB mark.
		Adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure is within ±2.0 dB of 10 DB mark.
		Adjust the signal generator for a 111 millivolt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter AVG scale indication (plus calibration curve correction factor - see figure is within ±2.5 dB of 0 DB mark.
		Adjust the signal generator for minimum output level.	

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
16	To evaluate sensitivity of average detector function in the 70-Hz tunable narrow band mode in conjunction with the 100,000-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector. Balance the modulator as described in paragraph 2-34. With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL and adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection. Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 0, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of -40, adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 02000 and note the meter AVG scale indication. **Note** The meter pointer will fluctuate due to the random nature of the noise and the narrow bandwidth. Determine the mean value of the meter AVG scale indication and denote this as the noise level. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100.	 Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60. Meter pointer deflects to a maximum indication when FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400. Meter indicates CAL on AVG scale. Meter indicates 33 dB or less on AVG scale.
17	To evaluate calibration curve accuracy (frequency response) when operating in the 70-Hz tunable narrow band mode in conjunction with the 600-ohm input impedance.	With the signal generator coupled directly to the INPUT connector as shown in figure 4-1, adjust the signal generator for minimum output level at 1 kHz. Balance the modulator as described in paragraph 2-34.	 Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
17 (cont)		With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the BAND-WIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL and adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection.	Meter pointer deflects to a maximum indication when FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 (the NARROW BAND dB dial will now read 80), adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication.	Meter indicates within ±0.5 dB of CAL on AVG scale.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication. Frequencies: 22 Hz, 100 Hz, 500 Hz, 3 kHz, 5 kHz, 7 kHz, 9 kHz, 11 kHz, 13 kHz and 15 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-6b) is within ±0.5 dB of CAL mark at each frequency.
18	To evaluate sensitivity of average detector function in the 70-Hz tunable narrow band mode in conjunction with the 600-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector. Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
18 (cont)		With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the BAND-WIDTH SELECTOR switch to 70HZ TUN-ABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FRE-QUENCY 20HZ-15KHZ counter reads be-tween 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screw-driver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of -20, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of -60, adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 02000 and note the meter AVG scale indication. **Note** The meter pointer will fluctuate due to the random nature of the noise and the narrow bandwidth. Determine the mean value of the meter AVG scale indication and denote this as the noise level. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80	Meter indicates 33 dB or less on AVG scale.
19	To evaluate calibra-tion curve accuracy (frequency response) when operating in the 70-Hz tunable narrow band mode in conjunc-tion with the 50-ohm input impedance.	With the signal generator coupled to the INPUT connector through a 600- to 50-ohm matching pad as shown in figure 4-1, adjust the signal generator for minimum ouput level at 1 kHz. Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
19 (cont)		With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 (the NARROW BAND dB dial will now read 80), adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication	Meter indicates within ±0.5 dB of CAL on AVG scale.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication. Frequencies: 22 Hz, 100 Hz, 3 kHz, 5 kHz, 7 kHz, 9 kHz, 11 kHz, 13 kHz and 15 kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-7b) is within ±0.8 dB of CAL mark at each frequency.
20	To evaluate sensitivity of average detector function in the 70-Hz tunable narrow band mode in conjunction with the 50-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector. Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
20 (cont)		With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of -20, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of -60, adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 02000 and note the meter AVG scale indication.	Meter indicates 23 dB or less on AVG scale.
		Note The meter pointer will fluctuate due to the random nature of the noise and the narrow bandwidth. Determine the mean value of the meter AVG scale indication and denote this as the noise level.	
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80.	
21	To evaluate passband response characteristics when operating in the 70-Hz tunable narrow band mode.	With the signal generator coupled to the INPUT connector through a 600- to 50-ohm matching pad, as shown in figure 4-1, adjust the signal generator for minimum output level at 2 kHz.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
21 (cont)		With the Detector function selector switch set to AVERAGE and the INPUT IMPEDANCE OHMS switch set to 100K, set the BAND-WIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 (the NARROW BAND dB dial will now read 80), adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL. Note and record the electronic counter indication. Carefully reduce the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter indicates 27 dB on the AVG scale. Note and record the electronic counter indication. Continue reducing the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter indicates 10 dB on the AVG scale. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 60. Repeat the above procedure until the meter indicates 20 DB on the AVG scale when the NARROW BAND dB dial indicates 20. Note and record the electronic counter indication. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80 and increase the signal generator frequency (while maintaining a constant output level of 351 millivolts rms) until the meter pointer deflects to a maximum indication. (This maximum should be CAL on the	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
21 (cont)		AVG scale.) Continue increasing the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter once again indicates 27 dB on the AVG scale. Note and record the electronic counter indication.	
		Continue increasing the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter indicates 10 DB on the AVG scale. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 60. Repeat the above procedure until the meter indicates 20 DB on the AVG scale when the NARROW BAND dB dial indicates 20. Note and record the electronic counter indication.	
		Compute the frequency difference between the electronic counter indications for AVG scale indications of 27 dB.	3-dB bandwidth is between 50 and 80 Hz.
		Compute the frequency difference between the electronic counter indications for AVG scale indications of 20 DB.	70-dB bandwidth is less than 800 Hz.
		Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80 and adjust the signal generator for minimum output level.	
22	To evaluate calibration curve accuracy (frequency response) and frequency tuning accuracy when operating in the 7-Hz tunable narrow band mode in conjunction with the 100,000-ohm input impedance.	With the signal generator coupled to the INPUT connector through a 600-ohm terminating resistor, as shown in figure 4-1, adjust the signal generator for minimum output level at 1,000 Hz, as indicated by the electronic counter.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BANDWIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
22 (cont)		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 (the NARROW BAND dB dial will indicate 100), adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication.	Meter indicates within ±0.5 dB of the CAL on AVG scale.
		Note the FREQUENCY 20HZ-15KHZ counter indication.	FREQUENCY 20HZ-15KHZ counter indication is between 00985 and 01015 (NOTE: Last digit must be interpolated.)
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below (as determined by the electronic counter). At each frequency adjust the signal generator for a 3.51 volt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection, and note both the meter AVG scale indication and the FREQUENCY 20HZ-15KHZ counter indications. Frequencies: 22 Hz, 100 Hz, 3,000 Hz, 5,000 Hz, 7,000 Hz, 9,000 Hz, 11,000 Hz, 13,000 Hz and 15,000 Hz	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-5c) is within ±0.5 dB of CAL mark at each frequency. FREQUENCY 20HZ-15KHZ counter indication for each signal frequency is tabulated below. Signal Frequency — FREQUENCY 20HZ-15KHZ Counter Indication 22 Hz — Between 00017 and 00027 100 Hz — Between 00094 and 00106 3,000 Hz — Between 02965 and 03035 5,000 Hz — Between 04945 and 05055 7,000 Hz — Between 06925 and 07075 9,000 Hz — Between 08905 and 09095 11,000 Hz — Between 10885 and 11115 13,000 Hz — Between 12865 and 13135

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
22 (cont)			Signal Frequency (Cont'd) / FREQUENCY 20HZ-15KHZ Counter Indication (Cont'd)
			15,000 Hz / Between 14845 and 15155
		Tune the signal generator to 1 kHz and adjust for minimum output level.	
23	To evaluate sensitivity of average detector function in the 7-Hz tunable narrow band mode in conjunction with the 100,000-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BANDWIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 0, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of -40 and note the meter AVG scale indication.	Meter indicates 23 dB or less on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100.	
24	To evaluate calibration curve accuracy (frequency response) when operation in the 7-Hz tunable narrow band mode in conjunction with the 600-ohm input impedance.	With the signal generator coupled directly to the INPUT connector, as shown in figure 4-1, adjust the signal generator for minimum output level at 1 kHz.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
24 (cont)		With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BANDWIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 (the NARROW BAND dB dial will now read 80), adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication.	Meter indicates within ±0.5 dB of CAL on AVG scale.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication. Frequencies: 22Hz, 100Hz, 3kHz, 5kHz, 7kHz, 9kHz, 11kHz, 13kHz and 15kHz Tune the signal generator to 1 kHz and adjust for minimum output level.	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-6b) is within ±0.5 dB of CAL mark at each frequency.
25	To evaluate sensitivity of average detector function in the 7-Hz tunable narrow band mode in conjunction with the 600-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector. Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
25 (cont)		With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BAND-WIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the INPUT IMPEDANCE OHMS switch to 600, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of -20, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of -60, adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 02000 and note the meter AVG scale indication. **Note** The meter pointer will fluctuate due to the random nature of the noise and narrow bandwidth. Determine the mean value of the meter AVG scale indication and denote this as the noise level.	Meter indicates 23 dB or less on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80.	
26	To evaluate calibration curve accuracy (frequency response) when operating in the 7-Hz tunable narrow band mode in conjunction with the 50-ohm input impedance.	With the signal generator coupled to the INPUT connector through a 600- to 50-ohm matching pad, as shown in figure 4-1, adjust the signal generator for minimum output level at 1 kHz.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BAND-WIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
26 (cont)		NARROW BAND dB dial indication of CAL, carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	
		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 (the NARROW BAND dB dial will now read 80), adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication.	Meter indicates within ±0.5 dB of CAL on AVG scale.
		Adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of exactly CAL.	Meter indicates CAL on AVG scale.
		Tune the signal generator, in sequence, to each of the frequencies listed below. At each frequency adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and note the meter AVG scale indication. Frequencies: 22 Hz, 100 Hz, 3 kHz, 5 kHz, 7 kHz, 9 kHz, 11 kHz, 13 kHz and 15 kHz	Meter AVG scale indication (plus calibration curve correction factor - see figure 2-7b) is within ±0.8 dB of CAL mark at each frequency.
		Tune the signal generator to 1 kHz and adjust the minimum output level.	
27	To evaluate sensitivity of average detector function in the 7-Hz tunable narrow band mode in conjunction with the 50-ohm input impedance.	Disconnect the Model NF-315 from the signal generator and cap the INPUT connector.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BANDWIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection (FREQUENCY 20HZ-15KHZ counter reads between 00600 and 01400) and adjust the NARROW BAND SIG LEVEL CAL screwdriver	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
27 (cont)		control, if necessary, to obtain a meter AVG scale indication of CAL.	
		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of -20, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB indication of -60, adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 02000 and note the meter AVG scale indication.	Meter indicates 14 dB or less on AVG scale.
		Note The meter pointer will fluctuate due to the random nature of the noise and the narrow bandwidth. Determine the mean value of the meter AVG scale indication and denote this as the noise level.	
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80.	
28	To evaulate passband response characteristics when operating in the 7-Hz tunable narrow band mode.	With the signal generator coupled to the INPUT connector through a 600- to 50-ohm matching pad, as shown in figure 4-1, adjust the signal generator for minimum output level at 2 kHz.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE, the INPUT IMPEDANCE OHMS switch set to 100K and the BANDWIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
28 (cont)		Set the INPUT IMPEDANCE OHMS switch to 50, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80 (the NARROW BAND dB dial will now read 80), adjust the signal generator for a 351 millivolt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL. Note and record the electronic counter indication. Carefully reduce the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter indicates 27 dB on the AVG scale. Note and record the electronic counter indication. Carefully continue reducing the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter indicates 10 DB on the AVG scale. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 60. Repeat the above procedure until the meter indicates 20 DB on the AVG scale when the NARROW BAND dB dial indicates 20. Note and record the electronic counter indication. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80 and increase the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter pointer deflects to a maximum indication. (This maximum should be CAL on the AVG scale.) Continue increasing the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter once again indicates 27 dB on the AVG scale. Note and record the electronic counter indication. Carefully continue increasing the signal generator frequency (while maintaining the output level constant at 351 millivolts rms) until the meter indicates 10 DB on the AVG scale. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 60. Repeat the above procedure until the meter indicates 20 DB on the AVG scale when the NARROW BAND dB dial indicates 20. Note and record the electronic counter indication.	Meter indicates CAL on AVG scale.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
28 (cont)		Compute the frequency difference between the electronic counter indications for AVG scale indications of 27 dB.	3-dB bandwidth is between 5 and 8 Hz.
		Compute the frequency difference between the electronic counter indications for AVG scale indications of 20 DB.	70-dB bandwidth is less than 100 Hz.
		Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80 and adjust the signal generator for minimum output level.	
29	To evaluate spurious response rejection.	With the signal generator coupled to the INPUT connector through a low-pass filter, as shown in figure 4-1, adjust the signal generator for minimum output level at 1 kHz.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND and the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, set the INPUT IMPEDANCE OHMS switch to 600 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80. Adjust the signal generator for a 1.11 volt rms output (as determined by the digital vtvm), carefully adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of 40 DB.	Meter indicates 40 DB on AVG scale.
		Note the FREQUENCY 20HZ-15KHZ counter indication.	
		Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 01500 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 20.	
		Carefully adjust the FREQUENCY TUNING control to harmonics of the applied signal and note the meter indication when tuning to each harmonic.	Meter AVG scale indication is below 30 DB for all harmonics of the applied signal.
		Adjust the signal generator for minimum output level and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80.	

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
30	To evaluate i-f and image frequency rejection.	With the signal generator coupled to the INPUT connector through the 600-ohm terminating resistor, as shown in figure 4-1, adjust the signal generator for minimum output level at exactly 100 kHz.	
		Balance the modulator as described in paragraph 2-34.	Meter indicates below CAL on AVG scale when NARROW BAND dB dial indicates 60.
		With the Detector function selector switch set to AVERAGE, and the INPUT IMPEDANCE OHMS switch set to 100K, set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 80, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 20, adjust the signal generator for a 1.11 volt rms output (as determined by the digital vtvm) and note the meter AVG scale indication.	Meter does not indicate above 30 DB on AVG scale as FREQUENCY TUNING control is scanned across the band.
		Adjust the signal generator for minimum output level.	
31	To evaluate operation of beat frequency oscillator and audio circuitry.	Set the Detector function selector switch to AVERAGE, set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter AVG scale indication of CAL.	Meter indicates CAL on AVG scale.
		Plug a 600-ohm headset into the PHONES connector and set the BFO switch to ON.	A 600-Hz tone can be heard.

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
31 (cont)		Rotate the AUDIO VOLUME control and note the headset response. Set the BFO switch to OFF.	AUDIO VOLUME control adjusts loudness of 600-Hz tone.
32	To evaluate operation of slideback detector function.	Set the Detector function selector switch to PEAK, set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL, adjust the FREQUENCY TUNING control to obtain a maximum meter pointer indication and adjust the NARROW BAND SIG LEVEL CAL screwdriver control, if necessary, to obtain a meter PEAK scale indication of CAL. Plug a 600-ohm headset into the PHONES connector. Rotate the SLIDEBACK control fully clockwise. Set the BFO switch to ON and set the Detector function selector switch to SLIDEBACK. With the AUDIO VOLUME control set to a point where the 600-Hz tone is barely audible, slowly rotate the SLIDEBACK control counterclockwise until the 600-Hz tone just starts to increase in volume. Note the meter PEAK scale indication. Set the BFO switch to OFF.	Meter indicates CAL on PEAK scale. Meter PEAK scale indication is within ±1.5 dB of CAL.
33	To evaluate operation of analog x-output circuitry.	Connnect a 1500-ohm resistor between terminals D and F of the REMOTE INDICATOR connector. Connect a VOM across the resistor. Rotate the FREQUENCY TUNING control throughout the band and note the VOM indication.	Analog x-output voltage varies linearly from 0 to ±10 volts (±5%) with rotation of the FREQUENCY TUNING control.

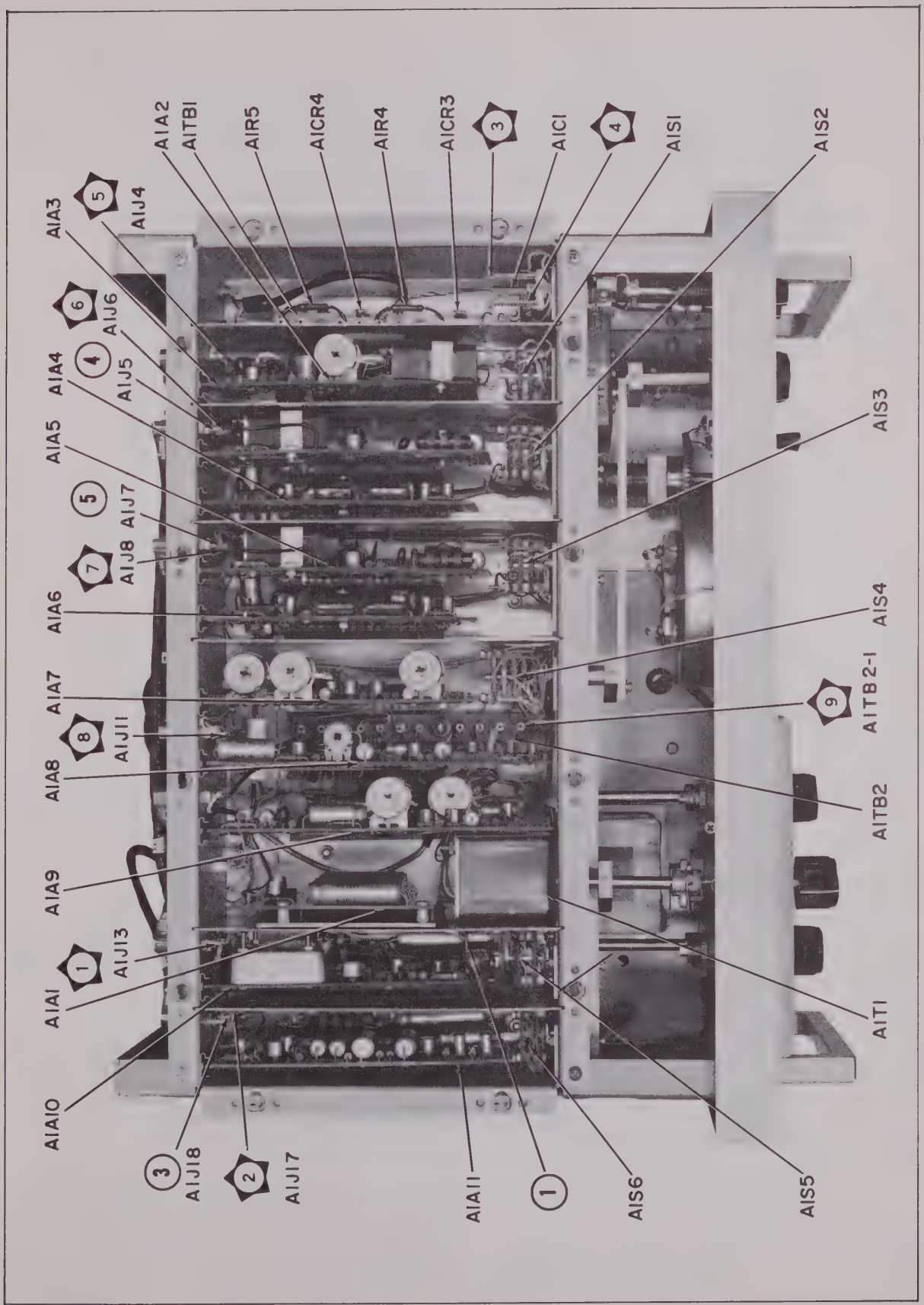


Figure 4-2. Top View of Model NF-315 Showing Component Locations and Trouble Localization Procedure Test Points

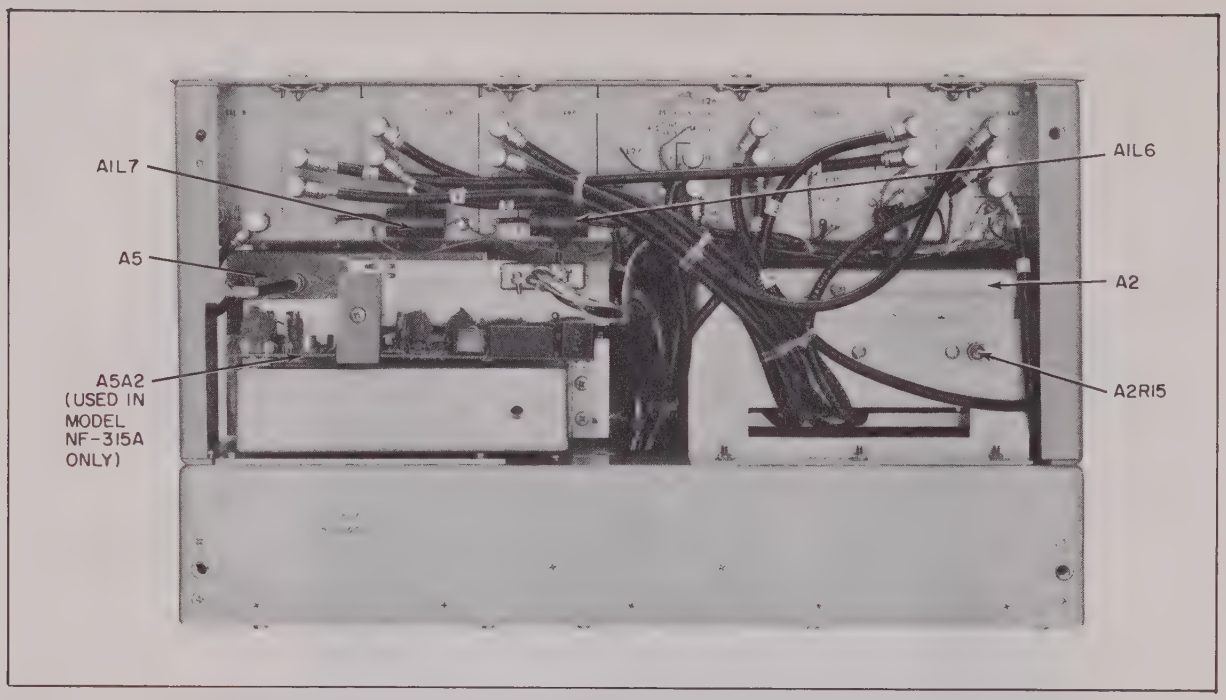


Figure 4-3. Rear View of Model NF-315 Showing Component Locations

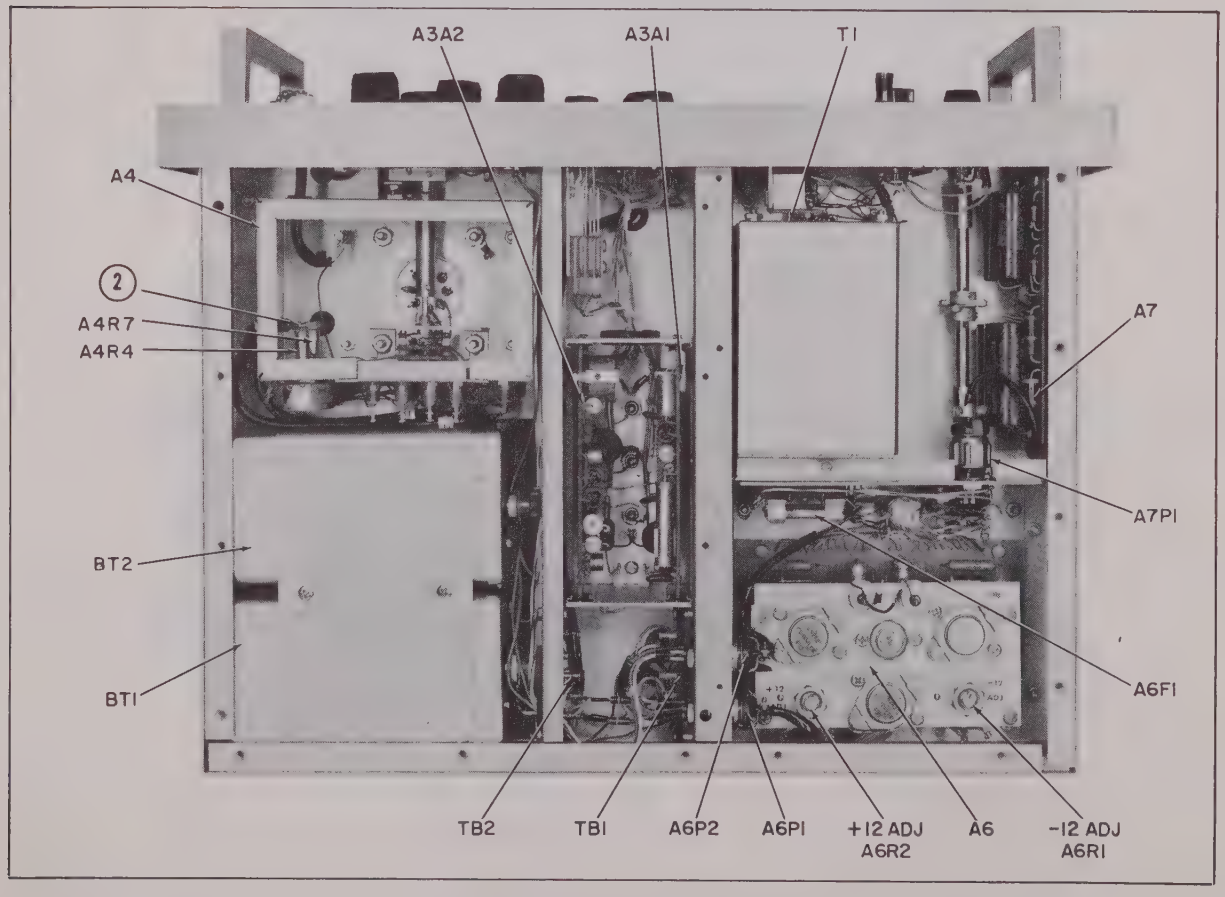


Figure 4-4. Bottom View of Model NF-315 Showing Component Locations and Trouble Localization Procedure Test Points

TABLE 4-4. POWER SUPPLY CHECK

Test Instrument	Range	Connect Positive Lead To	Connect Common Lead To	Normal Indication
Digitec Z-200B	+100VDC	Standoff between terminals 8 and 9 of A1TB2	Equipment ground	+12.00 volts
Simpson 260	+50VDC	TB1-1	Equipment ground	+16.2 to +19.8 volts
Simpson 260	+50VDC	TB1-4	Equipment ground	+12.3 to +13.1 volts
Digitec Z-200B	-100VDC	Standoff between terminals 4 and 5 of A1TB2	Equipment ground	-12.00 volts
Simpson 260	-50VDC	TB1-2	Equipment ground	-16.2 to -19.8 volts
Simpson 260	-50VDC	TB1-5	Equipment ground	-12.3 to -13.1 volts

Note

If desired, failure may be isolated to either the power distribution wiring (see figure 3-3) or to the plug-in boards of the i-f shelf by repeating the voltage measurements with all of the i-f shelf plug-in boards withdrawn.

4-11. LOCALIZING TROUBLE WITHIN THE POWER SUPPLY.

4-12. To localize a malfunction to d-c power supply printed circuit board A7 (see figure 4-5), detector line filter printed circuit board A1A1 (see figure 4-6) or voltage regulator assembly A6 (see figure 4-7), proceed as directed in table 4-5. If the malfunction has been localized to voltage regulator assembly A6, follow the steps below to facilitate repairs.

a. With the Model NF-315 set on its rear and the POWER selector switch set to OFF, remove the four screws that secure the heat sink assembly to the four mounting posts. Be sure to remove the two lower posts which become free when the screws are withdrawn.

b. Carefully fold out the heat sink assembly. All the components of the voltage regulator will now be visible and accessible.

4-13. SETTING POWER SUPPLY VOLTAGES.

4-14. To set the output voltages of the power supply, proceed as directed in the following steps.

a. With the Model NF-315 withdrawn from its case, connect the positive lead of a Digitec Z-200B digital voltmeter to the standoff between terminals 8 and 9 of terminal board A1TB2 (see figure 4-2). Connect the common lead to equipment ground. Set the digital voltmeter to the +100 volt range.

b. Couple the Model NF-315 to appropriate line power through an autotransformer. Set the autotransformer for minimum output voltage.

c. Set the POWER selector switch to AC OPERATE, energize the autotransformer and adjust the autotransformer output for rated nominal line voltage.

d. Adjust +12 ADJ screwdriver control R2 of A6 (see figure 4-4), if necessary, to obtain a digital voltmeter indication of +12.00 volts. Lock the shaft setting of the screwdriver control after the proper output voltage has been obtained.

e. Adjust the autotransformer for minimum output voltage and set the digital voltmeter to the -100 volt range. Connect the negative lead of the digital voltmeter to the standoff between terminals 4 and 5 of terminal board A1TB2 and keep the common lead connected to equipment ground.

f. Adjust the autotransformer output for rated nominal line voltage.

g. Adjust -12 ADJ screwdriver control R1 of A6 (see figure 4-4), if necessary, to obtain a digital voltmeter indication of -12.00 volts. Lock the shaft setting of the screwdriver control after the proper output voltage has been obtained.

h. De-energize and disconnect the equipment.

4-15. BATTERY REPLACEMENT.

4-16. To replace the batteries, proceed as directed in the following steps.

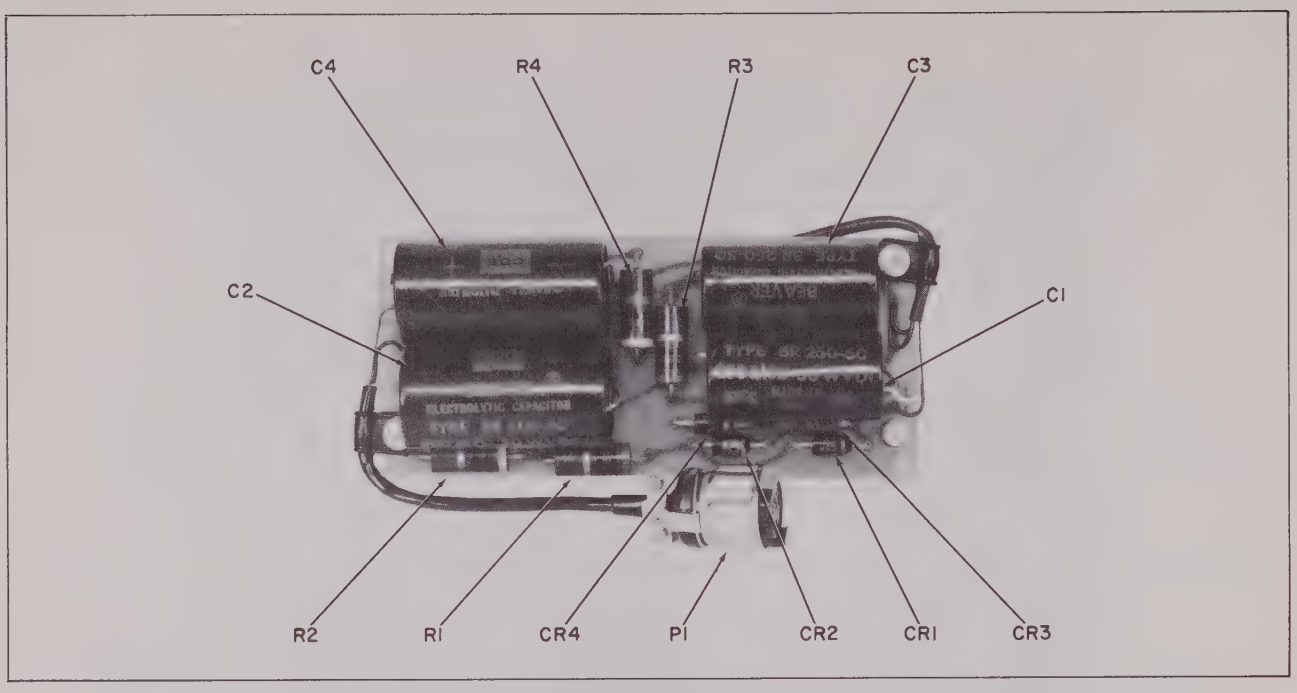


Figure 4-5. D-c Power Supply A7, Component Location Diagram

a. With the Model NF-315 withdrawn from its case (refer to paragraph 2-6) and set on its top, loosen the two screws that secure the battery retaining plate to the two mounting posts and remove the retaining plate.

b. Slide battery BT2 toward the center of the equipment and, grasping the battery from the end opposite the terminals, carefully lift the battery from the equipment. Transfer the leads to the replacement battery (one lead at a time while observing proper polarity). If only BT2 is to be replaced, proceed to step g.

c. Carefully remove the two posts with a pair of pliers.

d. Carefully lift battery BT1 from the equipment. Transfer the leads to the replacement battery (one lead at a time while observing proper polarity).

e. Install the replacement BT1 into the equipment.

f. Replace the two posts.

g. Install the replacement BT2 into the equipment.

h. Replace the battery retaining plate over the batteries and secure the plate to the posts.

4-17. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE.

4-18. To localize the cause of equipment malfunction to the input section, the wide band section, the narrow band section or the output section, remove the Model NF-315 from its case (refer to paragraph 2-6) and follow the systematic procedures supplied in table 4-6. (See figure 4-8.) If the audio and/or beat frequency circuits are inoperative, refer to paragraphs 4-37 and 4-38.

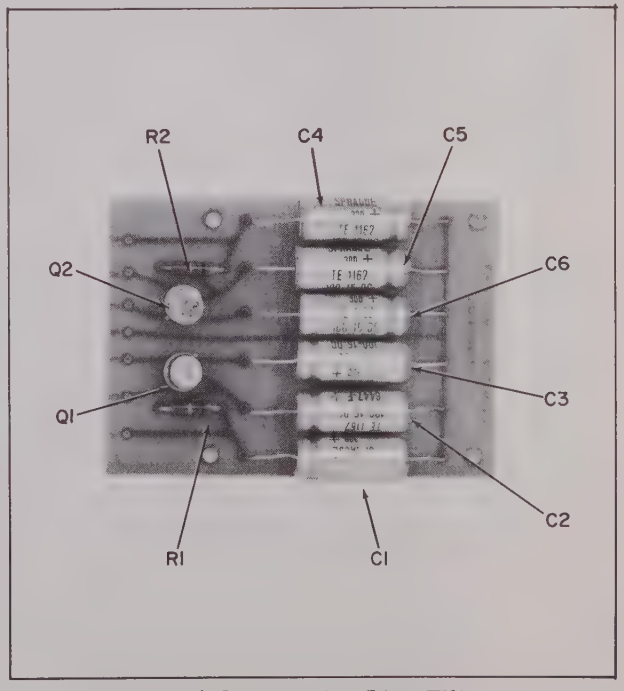


Figure 4-6. Detector Line Filter Component Board A1A1, Component Location Diagram

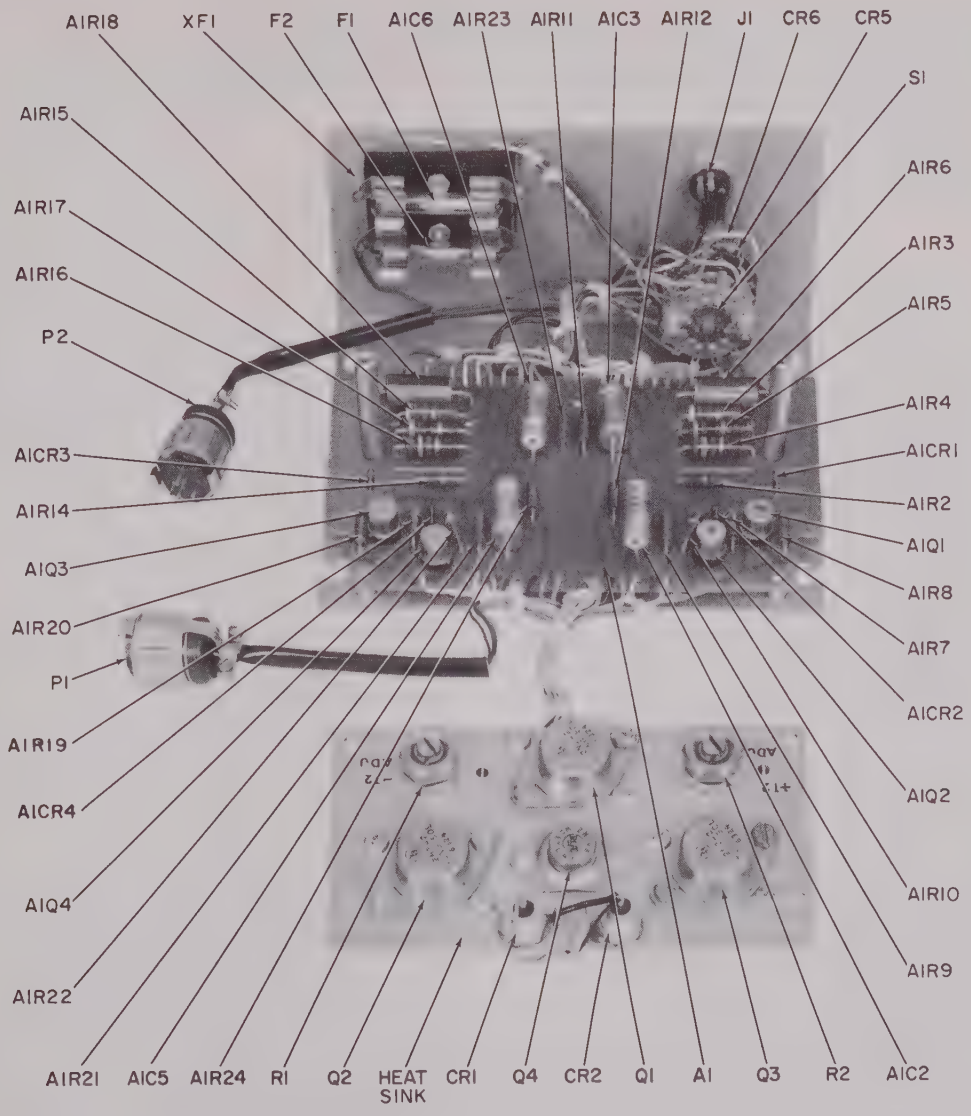


Figure 4-7. Voltage Regulator A6, Component Location Diagram

TABLE 4-5. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE

Step	Instructions	Normal Indication	If Indication Is Normal	If Indication Is Abnormal
1	With the POWER selector switch set to OFF, couple the Model NF-315 to line power as described in paragraphs 2-28 and 2-29. Set the POWER selector switch to AC OPERATE and observe the POWER lamp indication.	POWER lamp illuminates upon application of line power.	Set the POWER selector switch to OFF and proceed to step 2.	Check a-c line cord. Check POWER 0.25A SLO BLO fuse F1. Replace if necessary. Check POWER selector switch S1 and associated wiring. Check POWER lamp DS1 and resistor R1.
2	With the POWER selector switch set to OFF, connect the + lead of a Simpson 260 multimeter (set to the +50VDC range) to terminal 6 of A7 (see figure 4-4) and connect the common lead to equipment ground. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between +25 and +45 volts d-c (typical).	Set the POWER selector switch to OFF, disconnect the multimeter and proceed to step 3.	Check T1, A7CR3, A7CR4 and associated circuitry. Replace any defective components.
3	With the POWER selector switch set to OFF, connect the + lead of a Simpson 260 multimeter (set to the +50VDC range) to TB1-1 (see figure 4-4) and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between +16.2 and +19.8 volts d-c (typical).	Set the POWER selector switch to OFF and proceed to step 4.	Check fuse A6F2. Replace if necessary. Check A6CR2 and associated circuitry. Replace any defective component.
4	With the multimeter still connected between TB1-1 and TB1-3, set the POWER selector switch to BATTERY OPERATE and note the multimeter indication.	Multimeter indicates between +16.2 and +19.8 volts d-c (typical).	Set the POWER selector switch to OFF, disconnect the multimeter and proceed to step 5.	Check battery BT2. Replace if necessary (refer to paragraph 4-15).
5	With the POWER selector switch set to OFF, connect the + lead of a Simpson 260 multimeter (set to the +50VDC range) to TB1-4 and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between +12.3 and +13.1 volts d-c (typical).	Set the POWER selector switch to OFF, disconnect the multimeter and proceed to step 6.	Check A6Q4, A6A1Q3, A6A1Q4 and associated circuitry (refer to table 4-7). Replace any defective component.
6	With the POWER selector switch set to OFF, connect the positive lead of a Digitec Z-200B digital voltmeter (set to the +100 volt range) to the standoff between terminals 8 and 9 of A1TB2 (see figure 4-2) and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the digital voltmeter indication.	Digital voltmeter indicates +12.00 volts d-c.	Set the POWER selector switch to OFF, disconnect the digital voltmeter and proceed to step 7.	Adjust A6R2 to obtain the proper voltage (refer to paragraph 4-13). If the proper voltage cannot be obtained by adjustment of A6R2, check A1A1Q1 and associated circuitry (refer to table 4-8).

TABLE 4-5. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step	Instructions	Normal Indication	If Indication Is Normal	If Indication Is Abnormal
7	With the POWER selector switch set to OFF, connect the + lead of a Simpson 260 multimeter (set to the +50VDC range) to A6S5-1 (see figure 4-4) and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between +15 and +20 volts d-c (typical).	Set the POWER selector switch to OFF and proceed to step 8.	Check A6Q3, A6CR6 and associated circuitry (refer to table 4-7).
8	With the multimeter still connected between A6S1A-1 and TB1-3, set the POWER selector switch to FAST CHARGE and note the multimeter indication.	Multimeter indicates between +15 and +20 volts d-c (typical).	Set the POWER selector switch to OFF and proceed to step 9.	Check resistor A6A1R16.
9	With the multimeter still connected between A6A1A-1 and TB1-3, set the POWER selector switch to SLOW CHARGE and note the multimeter indication.	Multimeter indicates between +15 and +20 volts d-c (typical).	Set the POWER selector switch to OFF, disconnect the multimeter and proceed to step 10.	Check resistor A6A1R17.
10	With the POWER selector switch set to OFF, connect the + lead of a Simpson 260 multimeter (set to the -50VDC range) to terminal 4 of A7 and connect the common lead to equipment ground. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between -25 and -45 volts d-c (typical).	Set the POWER selector switch to OFF, disconnect the multimeter and proceed to step 11.	Check A7CR1, A7CR2 and associated circuitry. Replace any defective components.
11	With the POWER selector switch set to OFF, connect the + lead of a Simpson 260 multimeter (set to the -50VDC range) to TB1-2 and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between -16.2 and -19.8 volts d-c (typical).	Set the POWER selector switch to OFF and proceed to step 12.	Check fuse A6F1. Replace if necessary. Check A6CR1 and associated circuitry. Replace any defective components.
12	With the multimeter still connected between TB1-2 and TB1-3, set the POWER selector switch to BATTERY OPERATE and note the multimeter indication.	Multimeter indicates between -16.2 and -19.8 volts d-c (typical).	Set the POWER selector switch to OFF, disconnect the multimeter and proceed to step 13.	Check battery BT1. Replace if necessary (refer to paragraph 4-15).
13	With the POWER selector switch set to OFF, connect the +lead of a Simpson 260 multimeter (set to the -50VDC range) to TB1-5 and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between -12.3 and -13.1 volts d-c (typical).	Set the POWER selector switch to OFF, disconnect the multimeter and proceed to step 14.	Check A6Q1, A6A1Q1, A6A1Q2 and associated circuitry (refer to table 4-7). Replace any defective component.
14	With the POWER selector switch set to OFF, connect the negative lead of a Digitec Z-200B digital voltmeter (set to the -100 volt range) to the standoff between	Digital voltmeter indicates -12.00 volts d-c.	Set the POWER selector switch to OFF, disconnect the digital voltmeter and proceed to step 15.	Adjust A6R1 to obtain the proper voltage (refer to paragraph 4-13). If the proper voltage cannot be

TABLE 4-5. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step	Instructions	Normal Indication	If Indication Is Normal	If Indication Is Abnormal
14 (Cont)	terminals 4 and 5 of A1TB2 and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the digital voltmeter indication.			obtained by adjustment of A6R1, check A1A1Q2 and associated circuitry (refer to table 4-8).
15	With the POWER selector switch set to OFF, connect the + lead of a Simpson 260 multimeter (set to the -50VDC range) to A6S1B-1 and connect the common lead to TB1-3. Set the POWER selector switch to AC OPERATE and note the multimeter indication.	Multimeter indicates between -15 and -20 volts d-c (typical).	Set the POWER selector switch to OFF and proceed to step 16.	Check A6Q2, A6CR5 and associated circuitry (refer to table 4-7).
16	With the multimeter still connected between A6S1B-1 and TB1-3, set the POWER selector switch to FAST CHARGE and note the multimeter indication.	Multimeter indicates between -15 and -20 volts d-c (typical).	Set the POWER selector switch to OFF and proceed to step 17.	Check resistor A6A1R4.
17	With the multimeter still connected between A6S1B-1 and TB1-3, set the POWER selector switch to SLOW CHARGE and note the multimeter indication.	Multimeter indicates between -15 and -20 volts d-c (typical).	Set the POWER selector switch to OFF and disconnect the multimeter.	Check resistor A6A1R5.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
1		Connect an output vtvm between major test point ① (J13 of i-f shelf A1 - see figure 4-2) and equipment ground. Set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the Detector function selector switch to AVERAGE, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 0 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 40. Tune an oscillator to 1 kHz and adjust for minimum output level. Connect the oscillator to the INPUT connector as illustrated in figure 4-9. Set the calibrated attenuator for 50 dB insertion and adjust the oscillator output level to obtain an input vtvm indication of 11.1 millivolts rms. Note the indication of the output vtvm connected to major test point ①.	Output vtvm connected to major test point ① indicates between 80 and 120 millivolts rms (typical).	Without removing the output vtvm from major test point ①, proceed to major step 2.	Proceed to minor step 1.
	1	Connect the output vtvm between minor test point ① (the standoff beside switch S5 of i-f shelf A1 - see figure 4-2) and equipment ground and note the output vtvm indication.	Output vtvm connected to minor test point ① indicates 11.1 millivolts rms (typical).	20-kHz low-pass filter and broadband low-noise preamplifier plug-in board A10 of i-f shelf A1 is defective. Refer to paragraph 4-21.	Proceed to minor step 2.
	2	Connect the output vtvm between minor test point ② (the standoff beside INPUT IMPEDANCE OHMS switch A4S1 - see figure 4-4) and equipment ground and note the output vtvm indication.	Output vtvm connected to minor test point ② indicates 11.1 millivolts rms (typical).	Check wiring of WIDE BAND attenuator switch S1 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).	Check wiring of INPUT IMPEDANCE OHMS switch S1 of impedance matching network A4 (see figure 5-1).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
2		With the output vtvm connected between major test point ① (J13 of i-f shelf A1 - see figure 4-2), the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 0, the calibrated attenuator set for 50 dB insertion the oscillator tuned to 1 kHz and adjusted for an input vtvm indication of 11.1 millivolts rms, set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND and note the indication of the output vtvm connected to major test point ① .	Output vtvm connected to major test point ① indicates between 80 and 120 millivolts rms (typical).	Without removing the output vtvm from major test point ① , proceed to major step 3.	Check wiring of BANDWIDTH SELECTOR switch A1S5 (see figure 5-1).
3		With the output vtvm connected between major test point ① (J13 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE and the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 60, set the calibrated attenuator for 30 dB insertion and adjust the oscillator output level to obtain an input vtvm indication of 111 millivolts rms (at 1 kHz). Note the indication of the output vtvm connected to major test point ① .	Output vtvm connected to major test point ① indicates between 80 and 120 millivolts rms (typical).	Without removing the output vtvm from major test point ① , proceed to major step 4.	Check wiring of WIDE BAND attenuator switch S1 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).
4		With the output vtvm connected between major test point ① (J13 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE and the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch	Output vtvm connected to major test point ① indicates between 80 and 120 millivolts rms (typical).	Without removing the output vtvm from major test point ① , proceed to major step 5.	Check wiring of WIDE BAND attenuator switch S1 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).

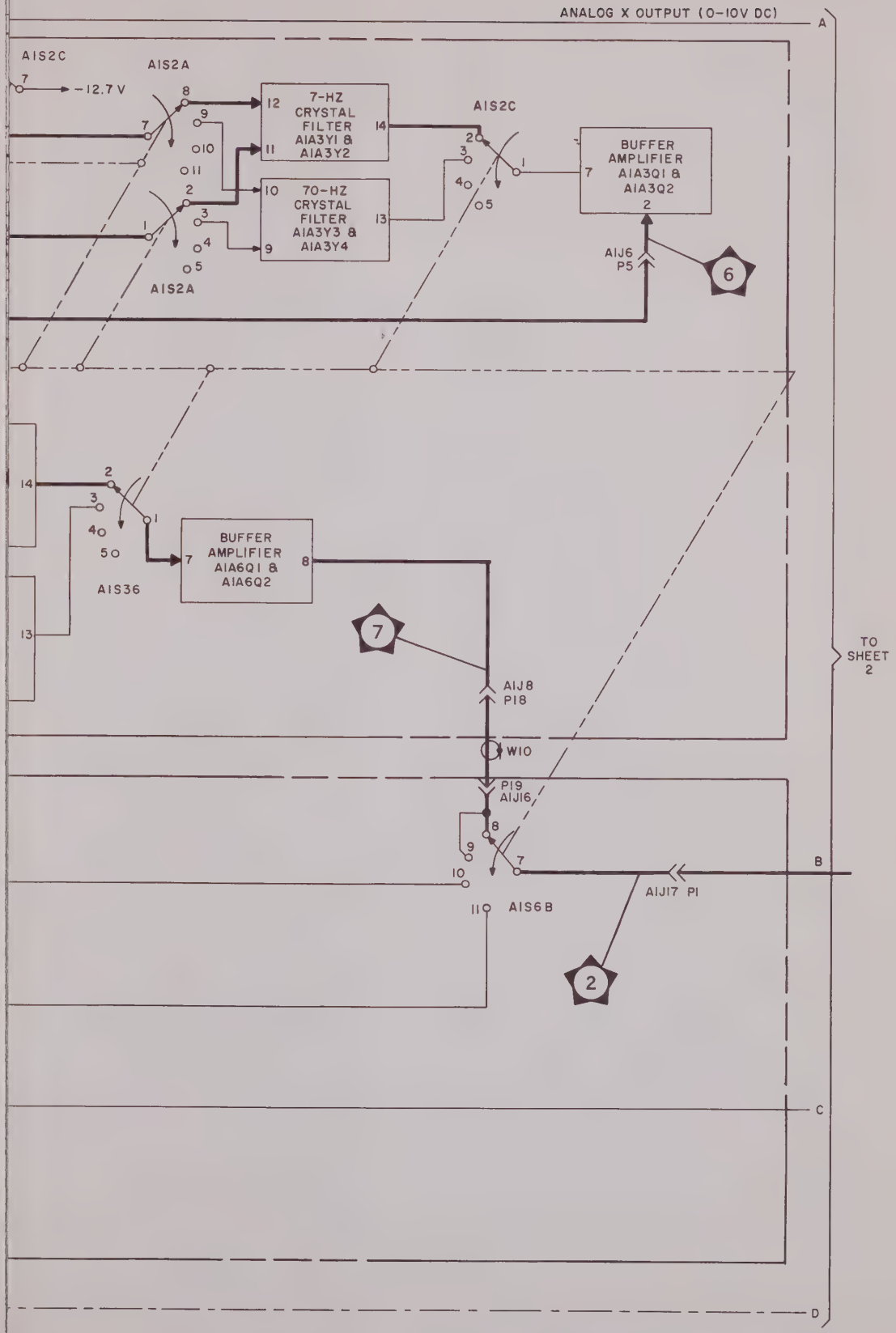


Figure 4-8. Detailed Block Diagram Showing Trouble Localization Procedure Test Points (Sheet 1 of 2)

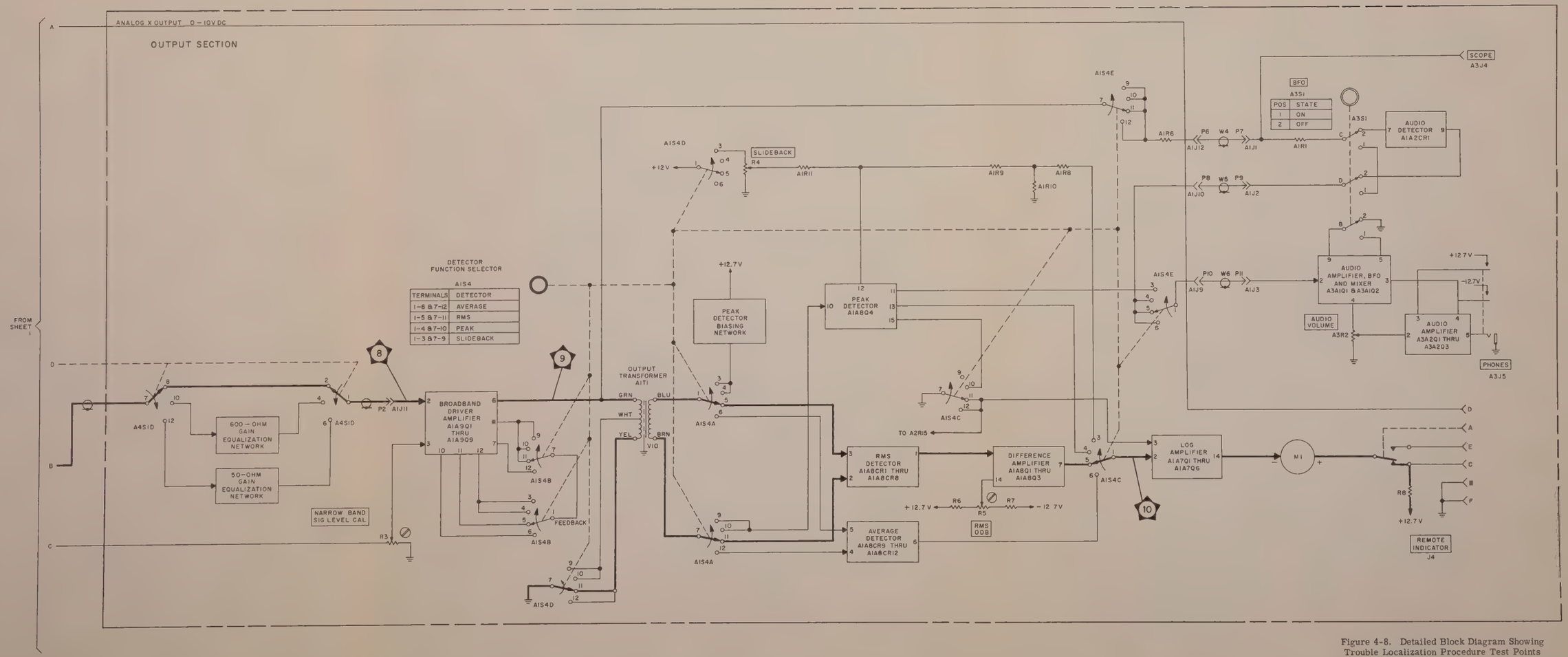


Figure 4-8. Detailed Block Diagram Showing Trouble Localization Procedure Test Points (Sheet 2 of 2)

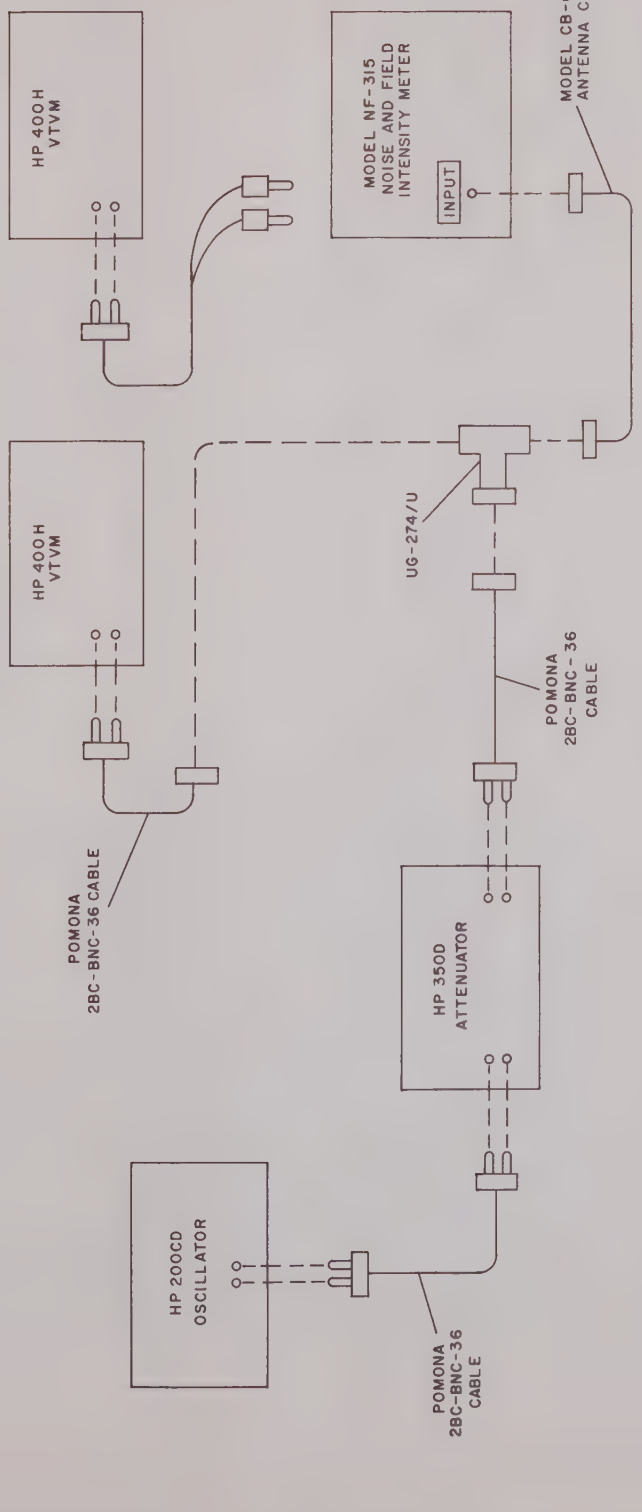


Figure 4-9. Initial Test Setup for Trouble Localization Procedure

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
4 (cont)		to obtain a WIDE BAND dB dial indication of 80, set the calibrated attenuator for a 10 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 1.11 volts rms. Note the indication of the output vtvm connected to major test point ① .			
5		With the output vtvm connected between major test point ① (J13 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE and the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms. Note the indication of the output vtvm connected to major test point ① .	Output vtvm connected to major test point ① indicates between 80 and 120 millivolts rms (typical).	Without removing the output vtvm from major test point ① , proceed to major step 6.	Check wiring of WIDE BAND attenuator switch S1 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).
6		With the output vtvm connected between major test point ① (J13 of i-f shelf A1 - see figure 4-2) and equipment ground, the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND and the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, adjust the oscillator for minimum output level at 1 kHz. Set the INPUT IMPEDANCE OHMS switch to 600, set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level to obtain an input vtvm indication of 1.11 volts rms. Note the indication of the output vtvm connected to major test point	Output vtvm connected to major test point ① indicates between 110 and 135 millivolts rms (typical).	Without removing the output vtvm from major test point ① , proceed to major step 7.	Check wiring of INPUT IMPEDANCE OHMS switch S1 of input impedance matching network A4 (see figure 5-1).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
7		With the output vtvm connected between major test point ① (J13 of i-f shelf A1 - see figure 4-2) and equipment ground, the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 80 and the calibrated attenuator set for 0 dB insertion, adjust the oscillator for minimum output level at 1 kHz. Set the INPUT IMPEDANCE OHMS switch to 50 and adjust the oscillator output level to obtain an input vtvm indication of 1.11 volts rms. Note the indication of the output vtvm connected to major test point ① .	Output vtvm connected to major test point ① indicates between 360 and 445 millivolts rms (typical).	Without removing the output vtvm from major test point ① , proceed to major step 8.	Check wiring of INPUT IMPEDANCE OHMS switch S1 of input impedance matching network A4 (see figure 5-1).
8		With the output vtvm connected between major test point ① (J13 of i-f shelf A1 - see figure 4-2) and equipment ground, the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 250KHZ FIXED WIDE BAND, set the INPUT IMPEDANCE OHMS switch to 100K and adjust the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Note the indication of the output vtvm connected to major test point ① .	Output vtvm connected to major test point ① indicates between 25.2 and 38.1 millivolts rms (typical).	Input section of Model NF-315 is operating properly. Disconnect the output vtvm from major test point ① and proceed to major step 9.	Check wiring of WIDE BAND attenuator switch S1 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22). Check 1-kHz calibration oscillator A1 of attenuator and 1-kHz calibration oscillator A2 (see figures 5-1 and 5-11 and refer to paragraph 4-22).
9		Connect the output vtvm between major test point ② (J17 of i-f shelf A1 - see figure 4-2) and equipment ground. Set the INPUT IMPEDANCE OHMS switch to 100K, set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and set the WIDE BAND SIG LEVEL CAL screwdriver control	Output vtvm connected to major test point ② indicates between 40 and 60 millivolts rms (typical).	With removing the output vtvm from major test point ② , proceed to major step 10.	Proceed to minor step 3.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
9 (cont)		to mid-range. Set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms. Note the indication of the output vtvm connected to major test point ⑫.			
	3	Connect the output vtvm between minor test point ③ (J18 of i-f shelf A1 - see figure 4-2) and equipment ground. Note the indication of the output vtvm.	Output vtvm connected to minor test point ③ indicates between 0.8 and 1.2 millivolts rms (typical).	Check wide band amplifier plug-in board A11 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-3 and refer to paragraph 4-23.	Check wiring of WIDE BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figures 5-1 and 5-11 and refer to paragraph 4-22).
10		With the output vtvm connected between major test point ⑫ (J17 of i-r shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the calibration attenuator set for 0 dB insertion and the oscillator adjusted to obtain an input vtvm indication of 11.1 volts rms (at 1 kHz), set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND and note the indication of the output vtvm connected to major test point ⑫.	Output vtvm connected to major test point ⑫ indicates between 40 and 60 millivolts rms (typical).	Without removing the output vtvm from major test point ⑫, proceed to major step 11.	Check wide band amplifier plug-in board A11 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-3 and refer to paragraph 4-23.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
11		With the output vtvm connected between major test point ② (J17 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE and the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, adjust the oscillator for minimum output level at 1 kHz and set the calibrated attenuator for 80 dB insertion. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 20 and increase the oscillator output level to obtain an input vtvm indication of 1.11 millivolts rms. Note the indication of the output vtvm connected to major test point ② .	Output vtvm connected to major test point ② indicates between 40 and 60 millivolts rms (typical).	Wide band section of Model NF-315 is operating properly. Disconnect the output vtvm from major test point ② and proceed to major step 12.	Check wiring of WIDE BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).
12		Connect the output vtvm (in parallel with an electronic counter and an oscilloscope) between major test point ③ (see figure 4-2) and equipment ground. With the INPUT IMPEDANCE OHMS switch set to 100K and the Detector function selector switch set to AVERAGE, adjust the oscillator for minimum output level. Set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100 and adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00000. Adjust the FREQUENCY CAL control, if necessary, to obtain an electronic counter indication of 100,000 Hz. Note the indication of the output vtvm and the display of the oscilloscope (both connected to major test point ③).	Output vtvm connected to major test point ③ indicates between 5 and 8.5 volts rms (typical) at 100,000 Hz. Oscilloscope connected to major test point ③ displays an undistorted sinusoid.	Disconnect the output vtvm and associated test equipment from major test point ③ and proceed to major step 13.	Check tunable local oscillator A5 and associated circuitry (see figures 5-1 and 5-10 and refer to paragraph 4-24).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
13		Connect the output vtvm (in parallel with an electronic counter and an oscilloscope) between major test point ④ (see figure 4-2) and equipment ground. With the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the NARROW BAND attenuator switch set to obtain a NARROW BAND dB dial indication of 100, the FREQUENCY TUNING control set to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00000 the FREQUENCY CAL control adjusted to obtain an electronic counter indication of 100,000 Hz and the oscillator adjusted for minimum output level at 1 kHz, note the indication of the output vtvm and the display of the oscilloscope (both connected to major test point ④.	Output vtvm connected to major test point ④ indicates between 5 and 8.5 volts rms (typical) at 100,000 Hz. Record this voltage. Oscilloscope connected to major test point ④ displays undistorted sinusoid.	Without removing the output vtvm and associated test equipment from major test point ④, proceed to major step 14.	Check tunable local oscillator A5 and associated circuitry (see figures 5-1 and 5-10 and refer to paragraph 4-24).
14		With the output vtvm (in parallel with the electronic counter and oscilloscope) connected between major test point ④ (see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, the oscillator adjusted for minimum output level, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100 and the NARROW BAND attenuator switch set to obtain a NARROW BAND dB dial indication of 100, adjust the FREQUENCY TUNING control to obtain FREQUENCY 20HZ-15KHZ counter indications, in 1,000-Hz increments, from 01000 to 15000. At each setting	Output vtvm connected to major test point ④ indicates within ±0.25 volts of the voltage recorded in major step 13. Voltage at each setting of the FREQUENCY TUNING control (for FREQUENCY 20HZ-15KHZ counter indications from 01000 to 15000) should not differ by more than 0.75 volts.	Disconnect the output vtvm and associated test equipment from major test point ④ and proceed to major step 15.	Calibrate frequency of tunable local oscillator A5 as described in paragraph 4-25.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
14 (cont)		of the FREQUENCY TUNING control note the indication of the output vtvm, the electronic counter and the oscilloscope (all connected to major test point ④).	Oscilloscope displays undistorted sinusoid at each setting of the FREQUENCY TUNING control. Electronic counter indications are tabulated below. FREQUENCY 20HZ-15KHZ Counter Indication / Electronic Counter Indication 01000 — 100,985 to 101,015 02000 — 101,975 to 102,025 03000 — 102,965 to 103,035 04000 — 103,955 to 104,045 05000 — 104,945 to 105,055 06000 — 105,935 to 106,065 07000 — 106,925 to 107,075 08000 — 107,915 to 108,085 09000 — 108,905 to 109,095 10000 — 109,895 to 110,105 11000 — 110,885 to 111,115 12000 — 111,875 to 112,125 13000 — 112,865 to 113,135	Disconnect the output vtvm and associated test equipment from major test point ④ and proceed to major step 15.	Calibrate frequency of tunable local oscillator A5 as described in paragraph 4-25.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
14 (cont)			FREQUENCY 20HZ-15KHZ Counter Indication / Electronic Counter Indication 14000 — 113,855 to 114,145 15000 — 114,845 to 115,155		
15		With the output vtvm (in parallel with an electronic counter) connected between major test point (5) (J4 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the NARROW BAND attenuator switch set to obtain a NARROW BAND dB dial indication of 100 and the Detector function selector switch set to AVERAGE, set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 01000. Carefully adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point (5). Note the indication of the output vtvm.	Output vtvm connected to major test point (5) indicates between 10 and 30 millivolts rms (typical). Record this value.	Without removing the output vtvm and associated test equipment from major test point (5), proceed to major step 16.	Check input crystal filter plug-in board A2 of i-f shelf A1 and associated circuitry (see figures 5-1 and 5-4 and refer to paragraph 4-26).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
16		With the output vtvm (in parallel with the electronic counter) connected between major test point (5) (J4 of i-f shelf A1- see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the NARROW BAND attenuator switch set to obtain a NARROW BAND dB dial indication of 100, the calibrated attenuator set for 0 dB insertion and the oscillator output level (at 1 kHz) adjusted to obtain an input vtvm indication of 11.1 volts rms, set the BANDWIDTH SELECTOR switch to 7HZ TUNABLE NARROW BAND. Carefully adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point (5). Note both the indication of the output vtvm.	Output vtvm connected to major test point (5) indicates between 20 and 40 millivolts rms (typical).	Disconnect the output vtvm and electronic counter from major test point (5) and proceed to major step 17.	Check input crystal filter plug-in board A2 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-4 and refer to paragraph 4-26.
17		With the output vtvm connected between major test point (6) (J6 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the NARROW BAND attenuator switch set to obtain a NARROW band dB dial indication of 100, the BANDWIDTH SELECTOR switch set to 7HZ TUNABLE NARROW BAND, the calibrated attenuator set for 0 dB insertion and the oscillator output level adjusted (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms, carefully adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point (6). Note and record the indication of the output vtvm.	Output vtvm connected to major test point (6) indicates 32 millivolts rms (typical).	Without removing the output vtvm from major test point (6), proceed to major step 18.	Disconnect the output vtvm from major test point (6) and proceed to minor step 4.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
	4	Connect the output vtvm between minor test point (4) (J5 of i-f shelf A1 - see figure 4-2) and equipment ground and note the output vtvm indication.	Output vtvm connected to minor test point (4) indicates between 0.2 and 0.4 millivolts rms (typical).	Check 100-kHz i-f amplifier plug-in board A4 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-5 and refer to paragraph 4-27. Check 100-kHz crystal filter plug-in board A3 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-6 and refer to paragraph 4-28.	Check wiring of NARROW BAND attenuator switch S2 of attenuator and 1 kHz calibration oscillator A-2 (see figure 5-1).
18		With the output vtvm connected between major test point (6) (J6 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the NARROW BAND attenuator switch set to obtain a NARROW BAND dB dial indication of 100, the calibrated attenuator set for 0 dB insertion and the oscillator output level adjusted to obtain an input vtvm indication of 11.1 volts rms (at 1 kHz), set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND and adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point (6) .	Output vtvm connected to major test point (6) indicates 32 millivolts rms (typical).	Without removing the output vtvm from major test point (6) , proceed to major step 19.	Check 100-kHz i-f crystal filter plug-in board A3 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-6 and refer to paragraph 4-28.
19		With the output vtvm connected between major test point (6) (J6 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial	Output vtvm connected to major test point (6) indicates 32 millivolts rms (typical).	Without removing the output vtvm from major test point (6) , proceed to major step 20.	Check wiring of NARROW BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
19 (cont)		indication of 100 and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, set the calibrated attenuator for 10 dB insertion, set the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 1.11 volts rms and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80. Adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point (6). Note the output vtvm indication.			
20		With the output vtvm connected between major test point (6) (J6 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100 and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, set the calibrated attenuator for 30 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 111 millivolts rms. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 60 and adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point (6). Note the output vtvm indication.	Output vtvm connected to major test point (6) indicates 32 millivolts rms (typical).	Disconnect the output vtvm from major test point (6) and proceed to major step 21.	Check wiring of NARROW BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).
21		With the output vtvm connected between major test point (7) (J8 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial	Output vtvm connected to major test point (7) indicates between 25 and 32 millivolts rms (typical).	Without removing the output vtvm from major test point (7), proceed to major step 22.	Disconnect the output vtvm from major test point (7) and proceed to minor step 5.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
21 (cont)		indication of 100, and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100, set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms. Adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point ⑦. Note the output vtvm indication.			
	5	With the output vtvm connected between minor test point ⑤ (J7 of i-f shelf A1 - see figure 4-2) and equipment ground, note the indication of the output vtvm.	Output vtvm connected to minor test point ⑤ indicates between 0.25 and 0.35 millivolts rms (typical).	Check 100-kHz i-f amplifier plug-in board A6 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-5 and refer to paragraph 4-27. Check 100-kHz i-f crystal filter plug-in board A5 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-6 and refer to paragraph 4-28.	Check wiring of NARROW BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).
22		With the output vtvm connected between major test point ⑦ (J8 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, set the calibrated attenuator for 10 dB insertion, adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 1.11 volts rms, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 80 and adjust the FREQUENCY TUNING control to obtain	Output vtvm connected to major test point ⑦ indicates 32 millivolts rms (typical).	Without removing the output vtvm from major test point ⑦, proceed to major step 23.	Check wiring of NARROW BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
22 (cont)		a maximum indication on the output vtvm connected to major test point (7). Note the output vtvm indication.			
23		With the output vtvm connected between major test point (7) (J8 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100 and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, set the calibrated attenuator for 30 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 111 millivolts rms. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 60 and adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point (7). Note the indication of the output vtvm.	Output vtvm connected to major test point (7) indicates 32 millivolts rms (typical).	Without removing the output vtvm from major test point (7), proceed to major step 24.	Check wiring of NARROW BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).
24		With the output vtvm connected between major test point (7) (J8 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100 and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, set the calibrated attenuator for 50 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 11.1 millivolts rms. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 40 and adjust the FREQUENCY TUNING control to obtain a maxi-	Output vtvm connected to major test point (7) indicates 32 millivolts rms (typical).	Without removing the output vtvm from major test point (7), proceed to major step 25.	Check wiring of NARROW BAND attenuator switch S2 of attenuator and 1-kHz calibration oscillator A2 (see figure 5-1 and refer to paragraph 4-22).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
24 (cont)		mum indication on the output vtvm connected to major test point ⑦. Note the output vtvm indication.			
25		With the output vtvm connected between major test point ⑦ (J8 of i-f shelf A1 - see figure 4-2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the Detector function selector switch set to AVERAGE, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the NARROW BAND attenuator switch set to obtain a NARROW BAND dB dial indication of 40, the calibrated attenuator set for 50 dB insertion and the oscillator output level (at 1 kHz) adjusted to obtain an input vtvm indication of 11.1 millivolts rms, set the BANDWIDTH SELECTOR switch to 7HZ TUNABLE NARROW BAND and adjust the FREQUENCY TUNING control to obtain a maximum indication on the output vtvm connected to major test point ⑦. Note the output vtvm indication.	Output vtvm connected to major test point ⑦ indicates 32 millivolts rms (typical).	Narrow band section of Model NF-315 is operating properly. Disconnect the output vtvm from major test point ⑦ and proceed to major step 26.	Check 100-kHz i-f crystal filter plug-in board A5 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-6 and refer to paragraph 4-28.
26		Connect the output vtvm between major test point ⑧ (J11 of i-f shelf A1 - see figure 4-2) and equipment ground. Set the INPUT IMPEDANCE OHMS switch to 100K, set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the calibrated attenuator for 0 dB insertion, set the output level of the oscillator (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms and set the WIDE BAND SIG LEVEL CAL screwdriver control to mid-	Output vtvm connected to major test point ⑧ indicates between 45 and 50 millivolts rms (typical).	Without removing the output vtvm from major test point ⑧, proceed to major step 27.	Check wiring of INPUT IMPEDANCE OHMS switch S1 of impedance matching network A4 (see figure 5-1).

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
26 (cont)		range. Note the indication of the output vtvm connected to major test point (8).			
27		With the output vtvm connected between major test point (8) (J11 of i-f shelf A1 - see figure 4-2) and equipment ground, the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, the WIDE BAND SIG LEVEL CAL screwdriver control set to mid-range, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, set the calibrated attenuator for 0 dB insertion and adjust the oscillator for minimum output level at 1 kHz. Set the INPUT IMPEDANCE OHMS switch to 600 and increase the oscillator output level to obtain an input vtvm indication of 1.11 volts rms. Note the indication of the output vtvm connected to major test point (8). Record this voltage.	Output vtvm connected to major test point (8) indicates between 45 and 50 millivolts rms (typical).	Without removing the output vtvm from major test point (8), proceed to major step 28.	Refer to paragraph 4-30 to adjust the input impedance gain equalization network.
28		With the output vtvm connected between major test point (8) (J11 on i-f shelf A1 - see figure 4-2) and equipment ground, the Detector function selector switch set to AVERAGE, the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, the WIDE BAND SIG LEVEL CAL screwdriver control set to mid-range, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100 and calibrated attenuator set for 0 dB insertion, set the INPUT IMPEDANCE OHMS switch to 50 and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 1.11 volts rms. Note the indication of the output vtvm connected to major test point (8).	Output vtvm connected to major test point (8) indicates the same voltage as that recorded in major step 27.	Disconnect the output vtvm from major test point (8) and proceed to major step 29.	Refer to paragraph 4-30 to adjust the input impedance gain equalization network.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
29		Connect an oscilloscope between major test point ⑨ (terminal 1 of i-f shelf terminal board TB2 - see figure 4-2) and equipment ground, set the INPUT IMPEDANCE OHMS switch to 100K, set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the WIDE BAND SIG LEVEL CAL screwdriver control to mid-range, set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms. Note the display of the oscilloscope connected to major test point ⑨.	Oscilloscope connected to major test point ⑨ displays a waveform having a peak-to-peak amplitude between 9 and 11 volts (typical).	Without removing the oscilloscope from major test point ⑨, proceed to major step 30.	Check broadband driver amplifier plug-in board A9 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-7 and refer to paragraph 4-31.
30		With the oscilloscope connected between major test point ⑨ (terminal 1 of i-f shelf terminal board TB2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the WIDE BAND SIG LEVEL CAL screwdriver control set to mid-range, the calibrated attenuator set for 0 dB insertion and the oscillator output level (at 1 kHz) adjusted to obtain an input vtvm indication of 7.07 volts rms, set the Detector function selector switch to PEAK. Note the display of the oscilloscope connected to major test point ⑨.	Oscilloscope connected to major test point ⑨ displays a waveform having a peak-to-peak amplitude between 8 and 12 volts (typical).	Without removing the oscilloscope from major test point ⑨, proceed to major step 31.	Check broadband driver amplifier plug-in board A9 of i-f shelf A1 and associated circuitry. See figures 5-1 and 5-7 and refer to paragraph 4-31.
31		With the oscilloscope connected between major test point ⑨ (terminal 1 of i-f shelf terminal	Oscilloscope connected to major test point ⑨	Disconnect the oscilloscope from major test	Check broadband driver amplifier plug-in board A-9 of i-f shelf A1 and

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
31 (cont)		board TB2) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100 and the WIDE BAND SIG LEVEL CAL screwdriver control set to mid-range, set the calibrated attenuator for 10 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 1.00 volts rms. Set the Detector function selector switch to RMS, set the RMS 0 DB screwdriver control to mid-range and note the display of the oscilloscope connected to major test point (9).	displays a waveform having a peak-to-peak amplitude between 0.5 and 1.5 volts (typical).	point (9) and proceed to major step 32.	associated circuitry. See figures 5-1 and 5-7 and refer to paragraph 4.31.
32		With the Model NF-315 unenergized, withdraw log amplifier plug-in board A7 (see figure 4-2) from its slot in i-f shelf A1. Mount the extender board into the vacated connector and mount the log amplifier board atop the extender board. Connect a digital d-c vtvm (set for measuring positive voltages) between major test point (10) (terminal 2 of log amplifier A7 - see figure 4-8) and equipment ground Energize the Model NF-315. Set the INPUT IMPEDANCE OHMS switch to 100K, set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the WIDE BAND SIG LEVEL CAL screwdriver control to mid-range, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 11.1 volts rms. Note the indication of the digital d-c voltmeter connected to major test point (10).	Digital d-v vtvm connected to major test point (10) indicates 1.4 volts d-c (typical).	Without removing the digital d-c vtvm from major test point (10) proceed to major step 33.	Check average detector circuitry on detector plug-in board A8 of i-f shelf A1. See figure 5-8 and refer to paragraph 4-32.

TABLE 4-6. SYSTEMATIC TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
33		With log amplifier A7 connected to the i-f shelf via the extended board, the digital d-c vtvm connected between major test point ⑩ (terminal 2 of log amplifier board A7 - see figure 4-8) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, the WIDE BAND SIG LEVEL CAL screwdriver control set to mid-range, the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, the calibrated attenuator set for 0 dB insertion and the oscillator output level (at 1 kHz) adjusted to obtain an input vtvm indication of 7.07 volts rms, set the Detector function selector switch to PEAK and note the indication of the digital d-c vtvm connected to major test point ⑩ .	Digital d-c vtvm connected to major test point ⑩ 1.4 volts d-c (typical).	Without removing the digital d-c vtvm from major test point ⑩ , proceed to major step 34.	Check peak detector circuitry on detector plug-in board A8 of i-f shelf A1. See figure 5-8 and refer to paragraph 4-32.
34		With log amplifier A7 connected to the i-f shelf via the extender board, the digital d-c vtvm connected between major test point ⑩ (terminal 2 of log amplifier board A7 - see figure 4-8) and equipment ground, the INPUT IMPEDANCE OHMS switch set to 100K, the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, the WIDE BAND SIG LEVEL CAL screwdriver control set to mid-range and the WIDE BAND attenuator switch set to obtain a WIDE BAND dB dial indication of 100, set the calibrated attenuator for 0 dB insertion, adjust the oscillator output level (at 1 kHz) to obtain an input vtvm indication of 1.00 volts rms, set the RMS 0 DB screwdriver control to mid-range and set the Detector function selector switch to RMS. Note the indication of the digital d-c vtvm connected to major test point ⑩ .	Digital d-c vtvm connected to major test point ⑩ indicates 1.4 volts d-c (typical).	Check log amplifier plug-in board A7 of i-f shelf A1. See figure 5-9 and refer to paragraph 4-33.	Check rms detector circuitry on detector plug-in board A8 of i-f shelf A1. See figure 5-8 and refer to paragraph 4-32.

4-19. TROUBLESHOOTING AND CALIBRATION PROCEDURES.

4-20. The troubleshooting and calibration procedures contained in paragraphs 4-21 through 4-38 permit the technician to find the cause of malfunction, effect the necessary repairs and, once the repair has been effected, calibrate the equipment so that it operates in accordance with the specifications detailed in paragraph 1-18.

Note

In checking the d-c bias voltages on transistor, note that one defective transistor or component can upset the other transistors if it occurs in a direct-coupled circuit. In all such cases not all transistors are necessarily defective if their bias voltages are not within the tabulated nominal range. These transistors should be checked individually either in the equipment (voltage substitution method) or outside the equipment.

4-21. 20-KHZ LOW-PASS FILTER AND BROADBAND LOW-NOISE PREAMPLIFIER A1A10, TROUBLESHOOTING. Proceed as directed below to troubleshoot this assembly. (See figure 4-2 for the location of this assembly and figure 5-2 for its schematic diagram.)

a. With the Model NF-315 energized, measure the voltage between terminal E9 of i-f shelf A1 and equipment ground - - this voltage should be between +12.3 and +13.1 volts (+12.7 volts nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

b. Measure the voltage between E10 of i-f shelf A1 and equipment ground - - this voltage should be between -12.3 and -13.1 volts (-12.7 volts nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

c. De-energize the Model NF-315 and withdraw plug-in board A10 from its slot in i-f shelf A1 (see figure 4-2). Install the extender board into the vacated connector and mount plug-in board A10 atop the extender board.

d. Set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and disconnect any signal source from the INPUT connector.

e. Energize the Model NF-315 and check the d-c voltages at transistors Q1 through Q5 (see figure 4-10 and table 4-9) of plug-in board A10. Replace any defective component.

f. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. Trace the 1-kHz calibration oscillator signal (using an oscilloscope) to locate any discontinuity. Effect the necessary repairs and/or replacements.

g. De-energize the Model NF-315 and replace plug-in board A10 back into i-f shelf A1.

h. Perform major steps 1 and 2 of table 4-8 to ascertain that the plug-in board is operating properly and then proceed to paragraph 4-36.

4-22. ATTENUATOR AND 1-KHZ CALIBRATION OSCILLATOR A2, TROUBLESHOOTING. Proceed as directed below to troubleshoot this assembly. (See figure 4-3 for the location of A2 and figure 5-11 for the schematic diagram of component board A1 of A2.)

a. With the Model NF-315 energized, measure the voltage between the feedthrough capacitor (located on the wall of A2) and equipment ground - - this voltage should be between -12.3 and -13.1 volts (-12.7 volts nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3). If this voltage is present, continue to step b.

b. De-energize the Model NF-315 and remove it from line power.

c. Unsolder the coaxial cable (which goes to the secondary of transformer A4T1 through switch A1S1) at the standoff near switch A4S1 (see minor test point (2) of figure 4-4).

d. Unsolder the coaxial cable (which goes to pin 7 of switch A1S5) at the standoff near A1S5 (see minor test point (1) of figure 4-2).

e. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of CAL.

f. Loosen the four couplings which link the BANDWIDTH SELECTOR switch, the Detector function selector switch and the two MODULATOR BALANCE controls to i-f shelf A1. Position these so that the i-f shelf is free to be removed.

g. Remove the four screws that secure i-f shelf A1 to the equipment frame.

h. Disconnect all cables from the coaxial connectors at the rear of i-f shelf A1. Unplug all cables emanating from A2.

i. Unsolder the wire at feedthrough capacitor C1 of A2 (located on the side of A2).

j. Unsolder the wire at the feedthrough beside capacitor A2C1.

k. Carefully lift the i-f shelf up, fold it over the rear of the equipment and rest it on the workbench.

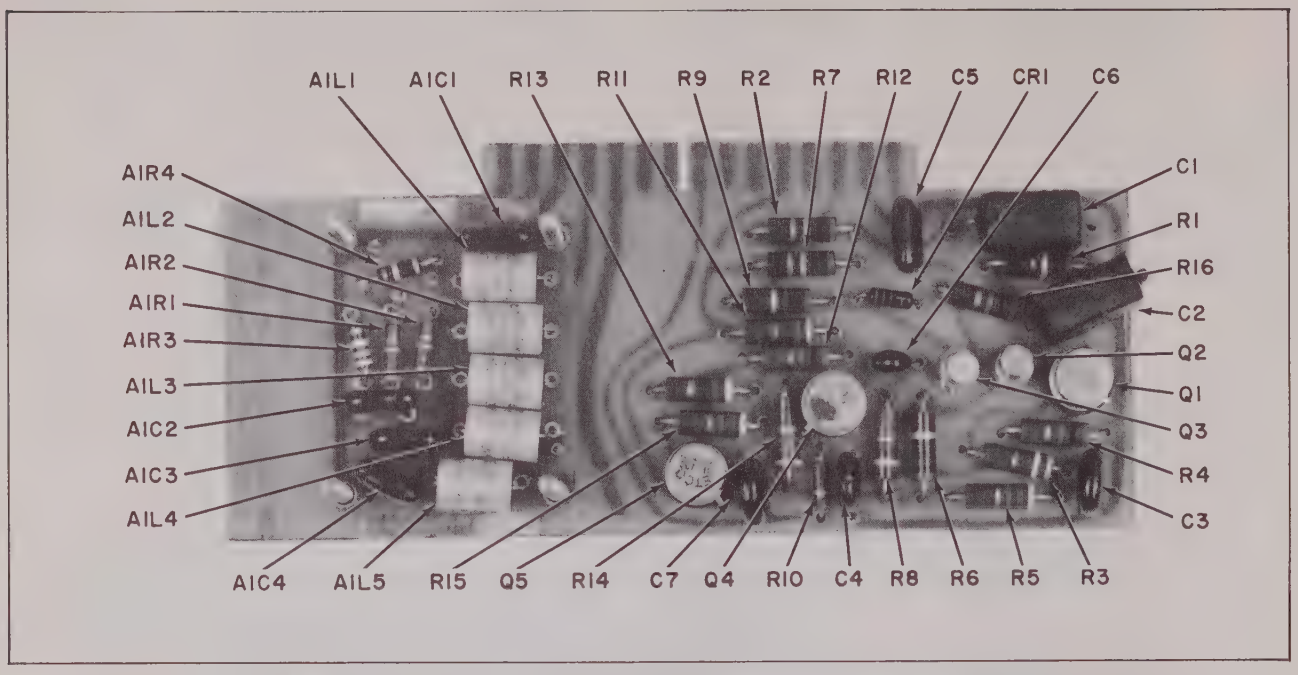


Figure 4-10. 20-kHz Low-pass Filter and Broadband Low-noise Preamplifier Plug-in Component Board A1A10, Component Location Diagram

l. Remove the five nuts that secure A2 to the equipment frame.

m. Carefully lift A2 up (to clear the mounting bolts) and away from the front panel (to disengage the linkages to the front panel WIDE BAND and NARROW BAND attenuator switches). Remove A2 from the equipment.

n. Place A2 on the workbench away from the Model NF-315.

o. Remove the four screws that secure the top cover to A2. Remove the cover. The components within the attenuator and 1-kHz calibration oscillator assembly will now be visible and accessible. The wiring and switching of the attenuator section can now be checked against figure 5-1. Effect the necessary repairs and/or replacements and then replace A2 into the Model NF-315 by following the reverse procedure of steps c through o. Proceed to step z. To check the 1-kHz calibration oscillator, continue to step p.

p. Set a d-c power supply for a negative output and adjust for minimum voltage. Connect the negative output terminal of the power supply to feedthrough capacitor C1 of A2. Connect the common terminal to the housing of A2.

q. Energize the power supply and adjust a -12.7 volt output.

r. Measure the voltage at transistor Q1 of component board A2A1 (see figure 4-11 and table 4-10). Effect the necessary repairs and/or replacements.

s. Connect a vtvm between terminals 1 and 2 of component board A1. Adjust screwdriver control R6 of A1, if necessary, to obtain a vtvm indication of 3.51 millivolts rms.

t. De-energize the power supply and disconnect it from A2.

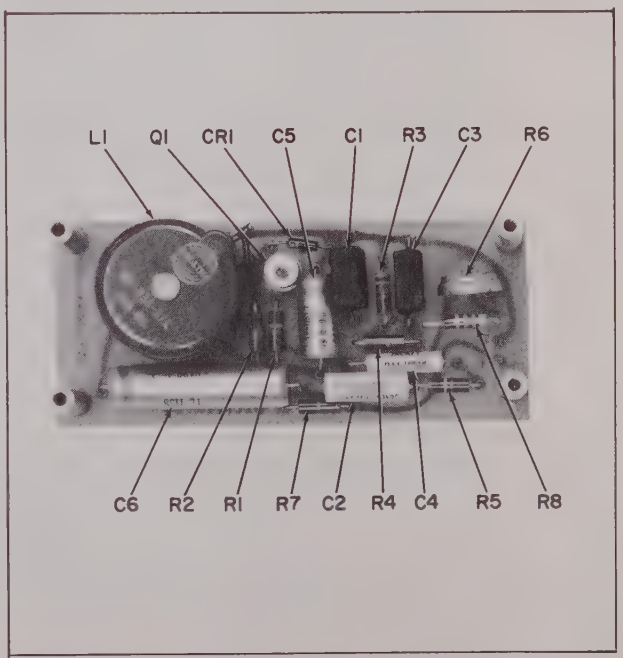


Figure 4-11. 1-kHz Calibration Oscillator Component Board A2A1, Component Location Diagram

u. Replace the attenuator and 1-kHz calibration oscillator assembly into the Model NF-315 following the reverse procedure of steps c through o.

v. Set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND, set the Detector function selector switch to AVERAGE, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and set the RMS 0 DB screwdriver control to mid-range.

w. Connect a vtvm between J13 of the i-f shelf (see major test point (1) of figure 4-2) and equipment ground and energize the Model NF-315.

x. Depress the RMS 0 DB PRESS toggle switch and note the vtvm indication - - the vtvm should indicate between 0.8 and 1.2 millivolts rms. If it does not, adjust screwdriver control R15 of A2 (see figure 4-3) to obtain a vtvm indication of 1.0 millivolts.

y. De-energize the Model NF-315 and disconnect the vtvm. Refer to paragraph 4-35.

z. Connect a vtvm between J13 of the i-f shelf (see major test point (1) of figure 4-2) and equipment ground and energize the Model NF-315.

aa. Set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND, set the Detector function selector switch to AVERAGE and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 40.

ab. Connect an oscillator (through a calibrated attenuator) to the INPUT connector. Tune the oscillator to 250 kHz and adjust for minimum output level. Set the calibrated attenuator for 70 dB insertion.

ac. Energize the Model NF-315 and adjust the oscillator output level to obtain a vtvm indication of 30 millivolts rms.

ad. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 60 and set the calibrated attenuator for 50 dB insertion.

ae. Adjust capacitor C2 of A2 (accessible through the hole on the left side of the Model NF-315) to obtain a vtvm indication of 30 millivolts rms.

af. De-energize the Model NF-315, disconnect the test equipment and refer to paragraph 4-36.

4-23. WIDE BAND AMPLIFIER A1A11, TROUBLESHOOTING. To troubleshoot this assembly, proceed as directed in the following steps. (See figure 4-2 for location of this assembly and figure 5-3 for its schematic diagram.)

a. With the Model NF-315 energized and the BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND, measure the voltage between E13 of i-f shelf A1 and equipment ground - - this voltage should be between +12.3 and +13.1 volts (+12.7 volts nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

b. Measure the voltage between E14 of i-f shelf A1 and equipment ground - - this voltage should be between -12.3 and -13.1 volts (-12.7 volts nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

c. De-energize the Model NF-315 and withdraw plug-in component board A11 from its slot in i-f shelf A1. Install the extender board into the vacated connector and mount A11 atop the extender board.

d. Set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and disconnect any signal source from the INPUT connector.

e. Energize the Model NF-315 and check the d-c voltages at transistors Q1 through Q5 of plug-in component board A11 (see figure 4-12 and table 4-11). Replace any defective component.

f. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and trace the 1-kHz calibration oscillator signal (using an oscilloscope) to locate any discontinuity between Q1 through Q3 and Q5. Effect the necessary repairs and/or replacements.

g. Set the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND and check Q4 for discontinuity. Effect the necessary repairs and/or replacements.

h. De-energize the Model NF-315 and replace A11 back into the i-f shelf. Perform major steps 9 and 10 of table 4-8 to ascertain that the plug-in board is operating properly.

4-24. TUNABLE LOCAL OSCILLATOR A5, TROUBLESHOOTING. To troubleshoot this assembly, proceed as directed in the following steps. (See figure 4-3 for the location of this assembly and figures 5-1 and 5-10 for schematic diagrams.)

a. With the Model NF-315 unenergized, remove the four screws that secure the cover of tunable local oscillator plug-in component board A1 to A5. Remove the cover.

b. Set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND and energize the Model NF-315.

c. Measure the voltage at the junction of A5L1 and A5C4 (see figure 4-13) with respect to equipment

ground - - this voltage should be between +12.3 and +13.1 volts (+12.7 volts nominal). If this voltage is not present, remove the plug-in component board. If the voltage is now present, the component board is defective (shorted); if the voltage is still not present, check the power distribution wiring (see figure 3-3).

d. Measure the voltage between the junction of A5L2 and A5C5 (see figure 4-13) and equipment ground - - this voltage should be between -12.3 and -13.1 volts (-12.7 volts nominal). If this voltage is not present, remove the plug-in component board. If the voltage is now present, the component board is defective (shorted); if the voltage is still not present, check the power distribution wiring (see figure 3-3).

e. De-energize the Model NF-315 and withdraw plug-in component board A1 from A5. Install the extender board into the vacated connector and mount A1 on the extender board.

f. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 10000 and energize the Model NF-315.

g. Measure the voltages at transistors Q1 through Q7 of A5A1 (see figure 4-14 and table 4-12). Effect the necessary repairs and/or replacements.

Note

If the transistor voltages are at the proper levels, check the wiring within tunable local oscillator A5.

h. De-energize the Model NF-315 and replace the component board back into A5.

i. Connect a vtvm (in parallel with an electronic counter and an oscilloscope) between A1TB1-5 and equipment ground.

j. Energize the Model NF-315 and adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00000. Adjust the FREQUENCY CAL control to obtain an electronic counter indication of exactly 100,000 Hz. Note the vtvm indication and the oscilloscope display. The vtvm should read between 5 and 8.5 volts rms and the oscilloscope display should be sinusoidal with no distortion. Record the vtvm indication.

k. Connect the vtvm (still in parallel with the electronic counter and the oscilloscope) between A1TB1-6 and equipment ground. The vtvm should read within ±0.25 volts of the voltage recorded in step j and the oscilloscope display should be sinusoidal with no distortion.

l. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 01000 and note the vtvm indication.

m. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 15000 and again note the vtvm indication. The vtvm indications of steps l and m should not differ by more than 0.75 volts.

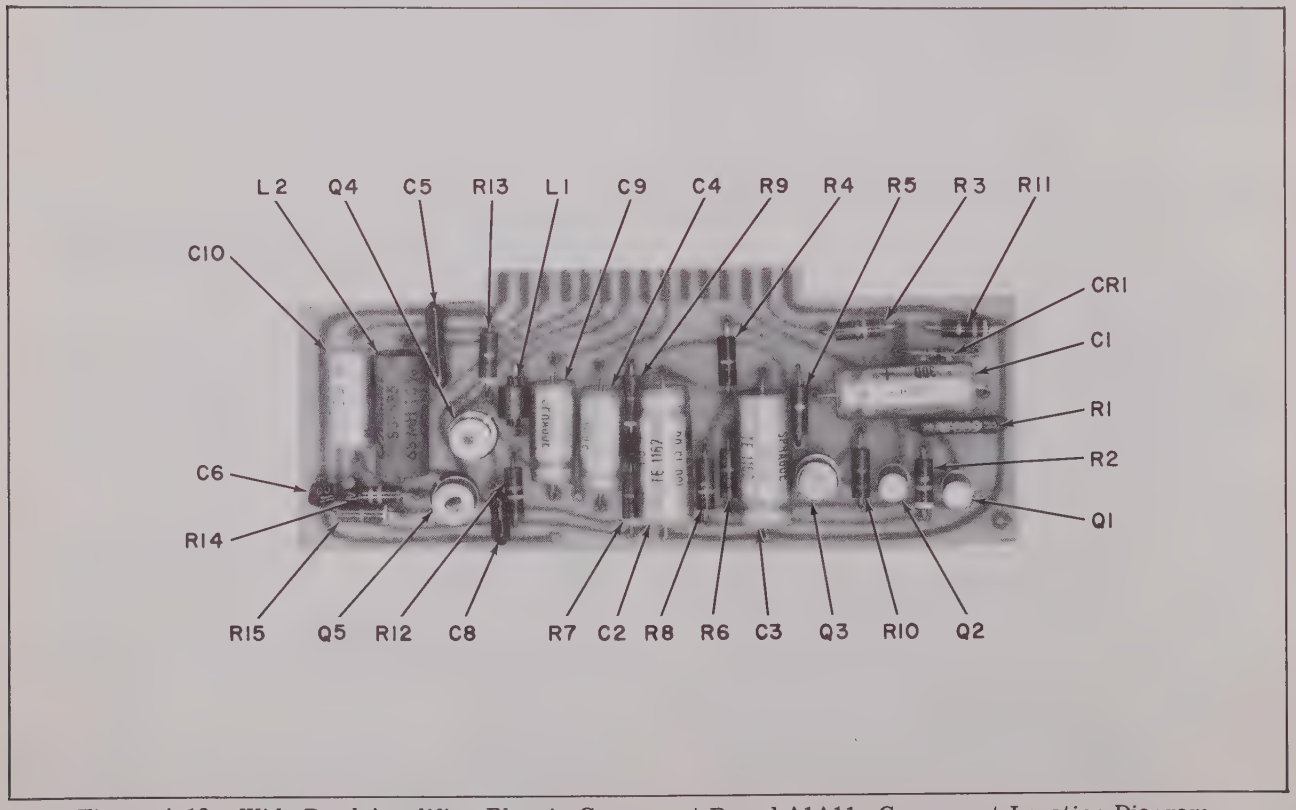


Figure 4-12. Wide Band Amplifier Plug-in Component Board A1A11, Component Location Diagram

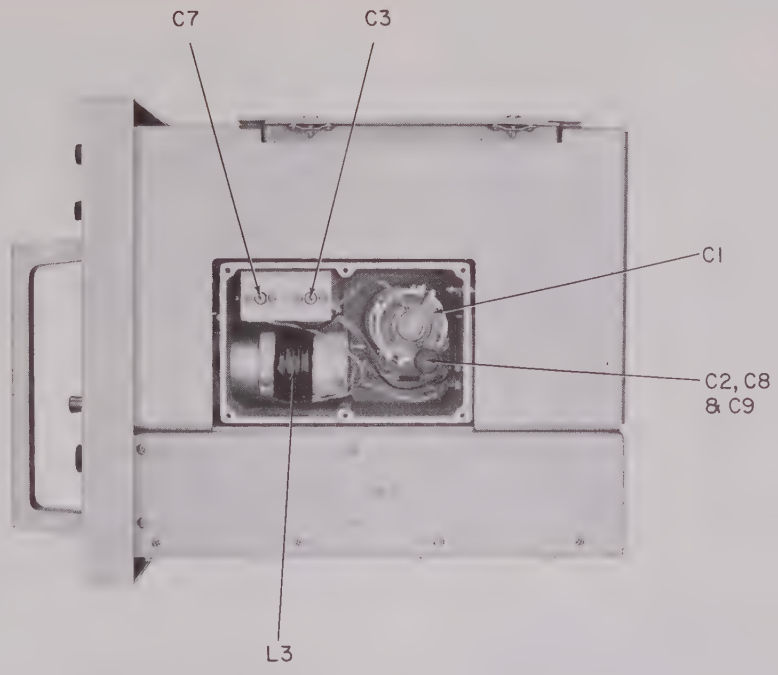


Figure 4-13. Tunable Local Oscillator A5, Component Location Diagram

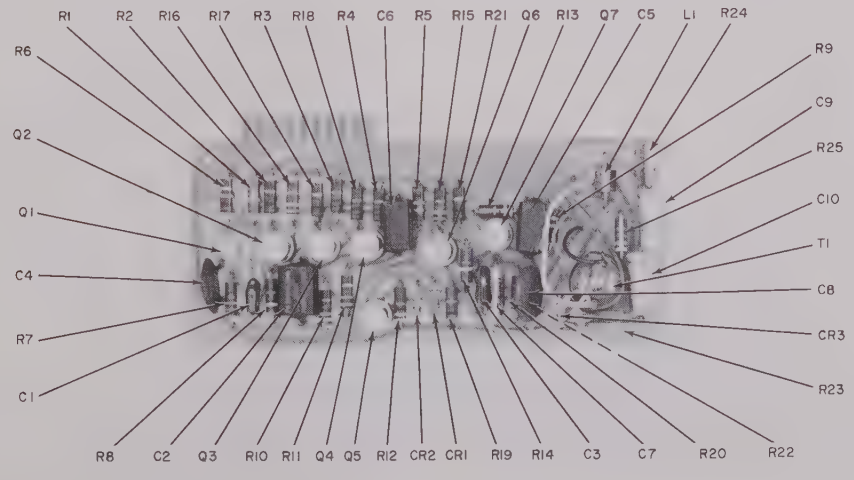


Figure 4-14. Tunable Local Oscillator Plug-in Component Board A5A1, Component Location Diagram

n. De-energize the Model NF-315 and proceed to paragraph 4-25.

4-25. TUNABLE LOCAL OSCILLATOR A5, FREQUENCY CALIBRATION. To calibrate the frequency of the tunable local oscillator, proceed as directed in the following steps.

a. Set the INPUT IMPEDANCE OHMS switch to 100K, set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 7HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100, adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00000 and set the FREQUENCY CAL control to the middle of its range.

Note

Do NOT remove any of the cover plates from tunable local oscillator assembly A5 while performing these steps.

b. Energize the Model NF-315.

c. Connect a vtvm (in parallel with an electronic counter) between A1TB1-6 and equipment ground. Note the vtvm indication - - it should be between 5 and 8.5 volts rms.

d. Adjust screwdriver set trimmer coil L4 of A5 (located on the front surface of the local oscillator housing above the FREQUENCY TUNING shaft and accessible through the space between the front panel and the i-f shelf) to obtain a maximum meter indication on the AVG scale.

Note

It may be necessary to reset the NARROW BAND attenuator switch to maintain an on-scale meter indication.

e. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of exactly 15000 and note the vtvm indication - - the vtvm should read between 5 and 8.5 volts rms.

f. Remove the vtvm and the electronic counter.

g. Connect an oscillator (in parallel with the electronic counter and the vtvm) to the INPUT connector. Tune the oscillator to 15 kHz and adjust the oscillator for minimum output level.

h. Set the NARROW BAND attenuator control to obtain a NARROW BAND dB dial indication of 100.

i. Carefully increase the oscillator output level to obtain a vtvm indication of 3.5 volts.

j. Carefully adjust the oscillator frequency to obtain a maximum deflection on the meter AVG scale. Note the electronic counter indication - - it should read between 14,940 and 15,060 Hz.

Note

1. If the electronic counter indication of step j is greater than 15,060 Hz, determine the frequency deviation from 15,000 Hz. Adjust the oscillator frequency to obtain an electronic counter indication of 15,000 Hz less this deviation.

2. If the electronic counter indication of step j is less than 14,940 Hz, determine the frequency deviation from 15,000 Hz. Adjust the oscillator frequency to obtain an electronic counter indication of 15,000 Hz plus this deviation.

k. Adjust FINE capacitor A5C7 and/or COARSE capacitor A5C3 (both located on the right side of the Model NF-315) to obtain a maximum meter AVG scale indication.

l. Repeat steps d through k until no further adjustments of the tuning capacitors are required to obtain the specified electronic counter indication.

m. Check the tunable local oscillator for frequency calibration as directed in major step 14 of table 4-8.

n. Refer to paragraph 4-36.

4-26. INPUT CRYSTAL FILTER A1A2, TROUBLESHOOTING. To troubleshoot this assembly, proceed as directed in the following steps. (See figure 4-3 for the location of this assembly and figure 5-4 for its schematic diagram.)

a. With the Model NF-315 energized and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, measure the voltage between E18 of i-f shelf A1 and equipment ground - - this voltage should be between +12.3 and +13.1 volts (+12.7 volts nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

b. De-energize the Model NF-315 and withdraw plug-in component board A2 from its slot in i-f shelf A1. Install the extender board into the vacated connector and mount the plug-in board atop the extender board.

c. Set the INPUT IMPEDANCE OHMS switch to 100K, set the Detector function selector switch to AVERAGE, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100 and disconnect any signal source from the INPUT connector.

d. Energize the Model NF-315 and measure the d-c voltages at transistors Q1 through Q4 of plug-in

component board A1A2 (see figure 4-15 and table 4-13). Replace any defective component.

e. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of approximately 01000.

f. Trace the 1-kHz calibration oscillator signal (using an oscilloscope) to locate any discontinuity. Effect the necessary repairs and/or replacements.

g. Replace A1A2 back into the i-f shelf and perform major steps 15 and 16 of table 4-8 to ascertain that input crystal filter plug-in component board A1A2 is operating properly.

h. Refer to paragraph 4-29.

4-27. 100-KHZ I-F AMPLIFIERS A1A4 AND A1A6, TROUBLESHOOTING. To troubleshoot these assemblies, proceed as directed in the following steps. (See figure 4-2 to locate these assemblies and figure 5-5 for their schematic diagram.)

Note

100-kHz i-f amplifiers A1A4 and A1A6 are identical assemblies. The procedure for troubleshooting A1A4 is detailed in this procedure and is applicable for A1A6. Any information concerning A1A6 is contained in parenthesis and immediately follows the equivalent information concerning A1A4.

a. With the Model NF-315 energized and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, measure the voltage between E1 (E2) of i-f shelf A1 and equipment ground - - this voltage should be between -12.3 and -13.1 volts. If this voltage is not present check the power distribution wiring. See figure 3-3.

b. De-energize the Model NF-315 and withdraw plug-in component board A4 (A6) from its slot in the i-f shelf, insert the extender board into the vacated connector and mount A4 (A6) atop the extender board.

c. Set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100 and disconnect any signal source from the INPUT connector.

d. Energize the Model NF-315 and measure the d-c voltages at transistors Q1 through Q4 of A1A4 (A1A6). See figure 4-16 and table 4-14. Replace any defective component.

e. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL.

f. Connect an oscilloscope between terminal 2 of A1A4 (A1A6) and equipment ground and adjust the FREQUENCY TUNING control to obtain a maximum amplitude oscilloscope display.

g. Trace the signal, using an oscilloscope, to locate any discontinuity. Effect the necessary repairs and/or replacements.

h. De-energize the Model NF-315 and replace the component board back into the i-f shelf.

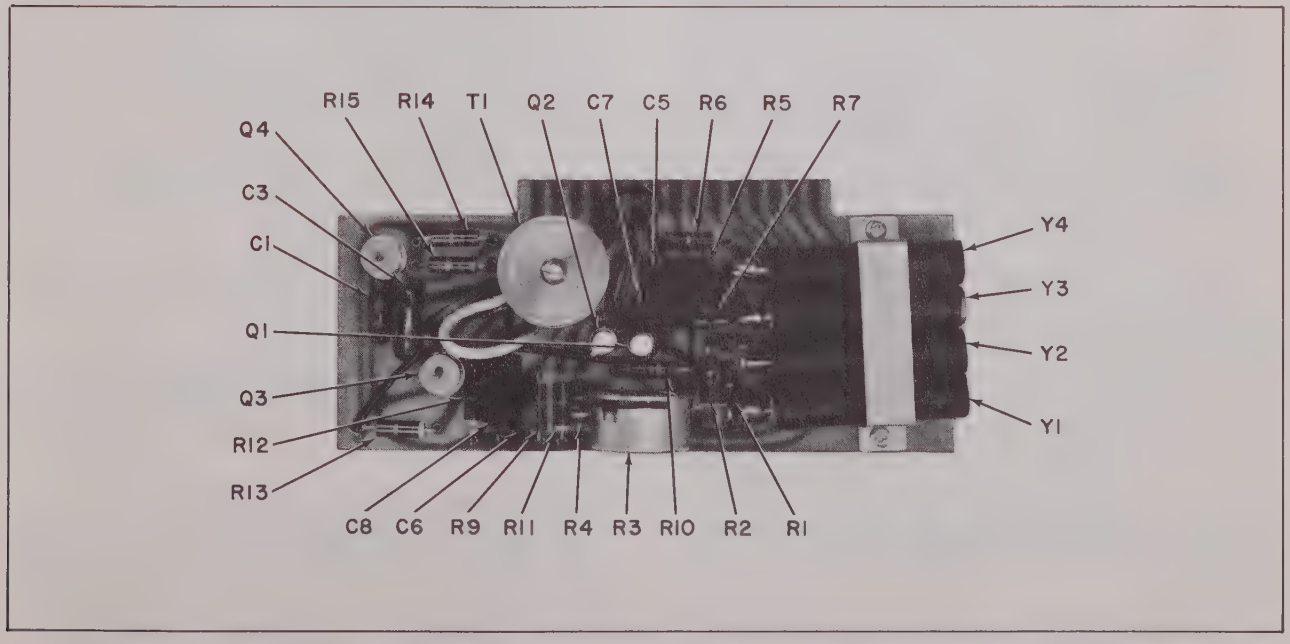


Figure 4-15. Input Crystal Filter Plug-in Component Board A1A2, Component Location Diagram

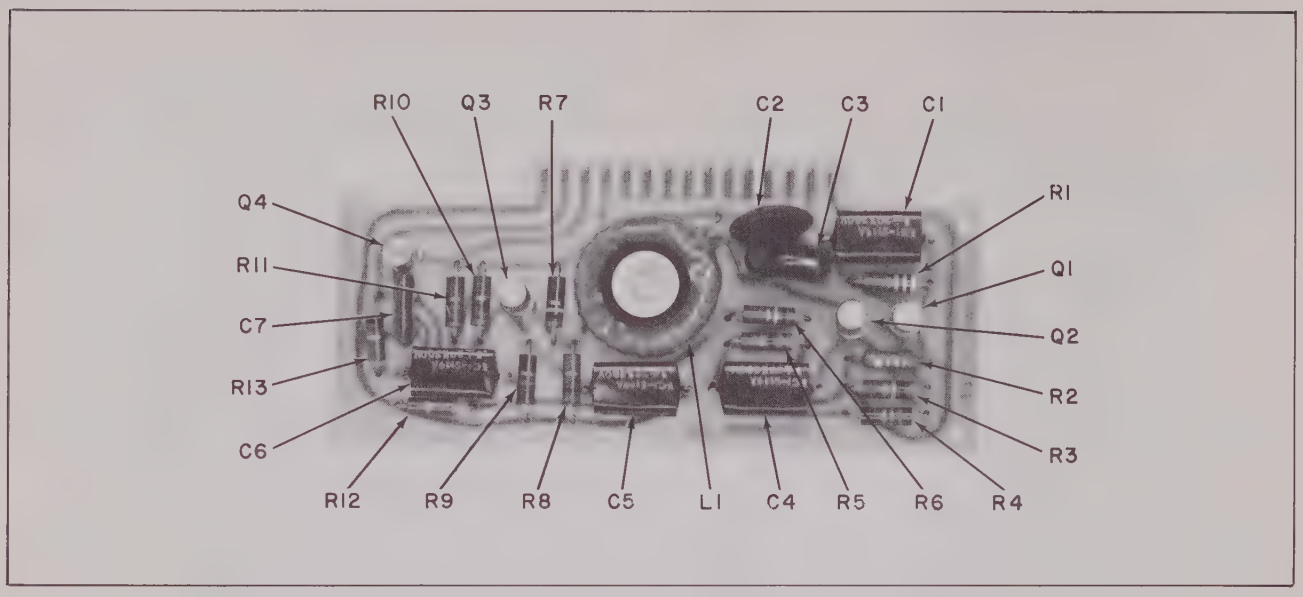


Figure 4-16. 100-kHz I-f Amplifier Plug-in Component Boards A1A4 and A1A6, Component Location Diagram

i. Perform major steps 17 and 18 (major steps 25 and 26) of table 4-8 to ascertain that A1A4 (A1A6) is operating properly.

j. Refer to paragraph 4-36.

4-28. 100-KHZ I-F CRYSTAL FILTERS A1A3 AND A1A5, TROUBLESHOOTING. To troubleshoot these assemblies, proceed as directed in the following steps. (See figure 4-2 to locate these assemblies and figure 5-6 for their schematic diagram.)

Note

100-kHz i-f crystal filters A1A3 and A1A5 are identical assemblies. The procedure for troubleshooting A1A3 is detailed in this procedure and is applicable to A1A5. Any information concerning A1A5 is contained in parenthesis and immediately follows the equivalent information concerning A1A3.

a. With the Model NF-315 energized and the BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND, measure the voltage between E1 (E2) of i-f shelf A1 and equipment ground - - this voltage should be between -12.3 and -13.1 volts. If this voltage is not present, check the power distribution wiring. See figure 3-3.

b. De-energize the Model NF-315 and withdraw plug-in component board A3 (A5) from its slot in the i-f shelf, insert the extender board into the vacated connector and mount A3 (A5) atop the extender board.

c. Set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100, set the Detector function selector switch to AVERAGE and disconnect any signal source from the INPUT connector.

d. Energize the Model NF-315 and check the d-c voltages at transistors Q1 and Q2 of A1A3 (A1A5). See figure 4-17 and table 4-15. Replace any defective component.

e. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL.

f. Connect an oscilloscope between terminal 4 of A1A3 (A1A5) and equipment ground and adjust the FREQUENCY TUNING control to obtain an oscilloscope display of maximum amplitude.

g. Trace the signal, using the oscilloscope, to locate any discontinuity. Effect the necessary repairs and or replacements.

h. De-energize the Model NF-315 and replace the plug-in component board back into the i-f shelf.

i. Perform major steps 17 and 18 (major steps 25 and 26) of table 4-8 to ascertain that A1A3 (A1A5) is operating properly.

j. Proceed to paragraph 4-29.

4-29. EQUALIZING GAIN BETWEEN 70-HZ AND 7-HZ TUNABLE NARROW BAND MODES. If component changes have been made in the circuits of A1A2, A1A3 or A1A5, equalize the gain between the 70-Hz and 7-Hz tunable narrow band

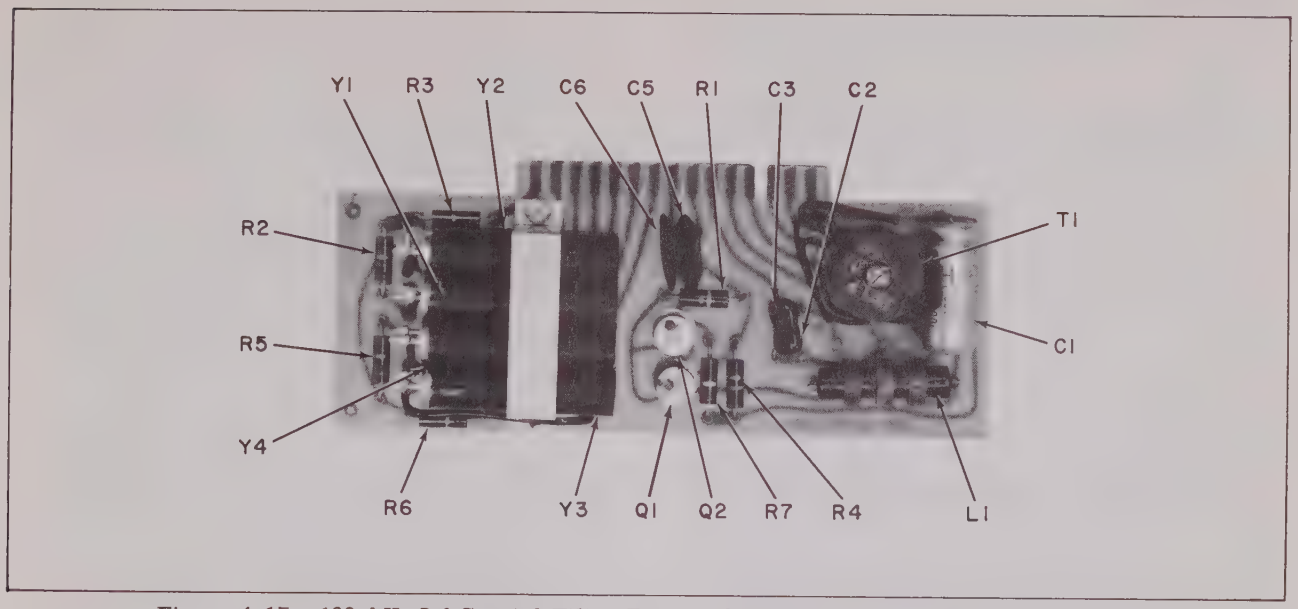


Figure 4-17. 100-kHz I-f Crystal Filter Plug-in Component Boards A1A3 and A1A5, Component Location Diagram

modes of operation as directed in the following steps.

Note

This procedure assumes that A1A2, A1A3 and A1A5 have been checked out (see table 4-8) and are operating properly.

a. Connect an oscillator (in parallel with a vtvm) to the INPUT connector. Tune the oscillator to 1 kHz and adjust for minimum output level.

b. Set the INPUT IMPEDANCE OHMS switch to 100K, set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100.

c. Energize the Model NF-315 and adjust the oscillator to obtain a vtvm indication of 3.51 millivolts rms.

d. Adjust the FREQUENCY TUNING control to obtain a maximum meter indication on the AVG scale. Adjust the NARROW BAND SIG LEVEL CAL screwdriver control to obtain a meter AVG scale indication of exactly CAL.

e. Set the BANDWIDTH SELECTOR switch to 7HZ TUNABLE NARROW BAND and carefully adjust the FREQUENCY TUNING control to obtain a maximum meter AVG scale indication.

f. Adjust potentiometer R3 of input crystal filter plug-in component board A1A2 (see figure 4-15) to obtain a meter AVG scale indication of exactly CAL.

g. De-energize the Model NF-315 and proceed to paragraph 4-36.

4-30. INPUT IMPEDANCE GAIN EQUALIZATION. To equalize the overall equipment gain between the different input impedances, proceed as directed in the following steps.

a. Set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the Detector function selector switch to AVERAGE, set the INPUT IMPEDANCE OHMS switch to 100K and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.

b. Connect an oscillator (in parallel with a digital vtvm) to the INPUT connector. Adjust the oscillator for minimum output level at 1 kHz.

c. Energize the Model NF-315.

d. Increase the oscillator output level to obtain a digital vtvm indication of 3.51 volts rms.

e. Adjust the WIDE BAND SIG LEVEL CAL screwdriver control to obtain a meter AVG scale indication of exactly CAL.

f. Adjust the oscillator for minimum output level and set the INPUT IMPEDANCE OHMS switch to 600.

g. Carefully increase the oscillator output level to obtain a digital vtvm indication of 351 millivolts rms.

h. Adjust screwdriver control R7 of input impedance matching network A4 (see figure 4-4) to obtain a meter AVG scale indication of exactly CAL.

i. Adjust the oscillator for minimum output level and set the INPUT IMPEDANCE OHMS switch to 50.

j. Carefully increase the oscillator output level to obtain a digital vtvm indication of 351 millivolts rms.

k. Adjust screwdriver control R4 of input impedance matching network A4 (see figure 4-4) to obtain a meter AVG scale indication of exactly CAL.

l. De-energize the equipment, disconnect the test equipment and refer to paragraph 4-36.

4-31. BROADBAND DRIVER AMPLIFIER A1A9, TROUBLESHOOTING. To troubleshoot this assembly, proceed as directed in the following steps. (See figure 4-2 for the location of this assembly and figure 5-7 for its schematic diagram.)

a. With the Model NF-315 unenergized, withdraw broadband driver amplifier plug-in component board A9 from its slot in the i-f shelf. Install the extender board in the vacated connector and mount the component board atop the extender board.

b. Energize the Model NF-315 and measure the voltage between terminal 14 of the component board and equipment ground. This voltage should be +12.00 volts. If this voltage is not present, check the power distribution wiring (see figure 3-3).

c. Measure the voltage between terminal 13 of the component board and equipment ground. This voltage should be -12.00 volts. If this voltage is not present, check the power distribution wiring (see figure 3-3).

d. Set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the Detector function selector switch to AVERAGE and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.

e. With no signal source connected to the INPUT connector, measure the d-c voltages at transistors Q1 through Q9 of plug-in component board A1A9. (See figure 4-18 and table 4-16.) Replace any defective component.

f. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL.

g. Trace the 1-kHz calibration oscillator signal, using an oscilloscope, to locate any discontinuity. Effect the necessary repairs and/or replacements.

h. De-energize the Model NF-315 and replace the component board back into the i-f shelf.

i. Perform major steps 30, 31 and 32 to ascertain that broadband driver amplifier plug-in component board A1A9 is functioning properly.

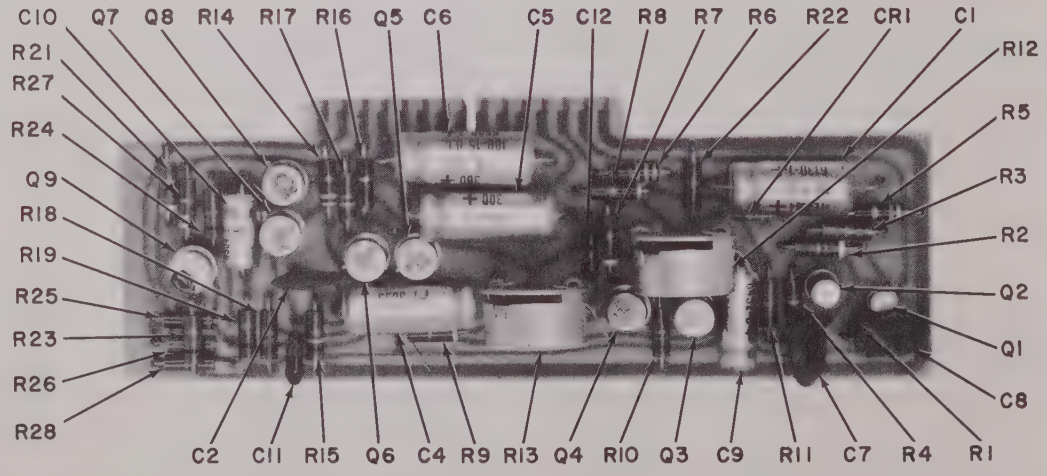


Figure 4-18. Broadband Driver Amplifier Plug-in Component Board A1A9, Component Location Diagram

j. Proceed to paragraph 4-34.

4-32. DETECTOR A1A8, TROUBLESHOOTING. To troubleshoot this assembly, proceed as directed in the following steps. (See figure 4-2 to locate this assembly and figure 5-8 for its schematic diagram.)

a. With the Model NF-315 unenergized, withdraw detector plug-in component board A8 from its slot in i-f shelf A1. Install the extender board into the vacated connector and mount component board A1A8 atop the extender board.

b. Energize the Model NF-315 and measure the voltage between terminal 9 of A1A8 and equipment ground. This voltage should be +12.00 volts. If this voltage is not present, check the power distribution wiring (see figure 3-3).

c. Measure the voltage between terminal 8 of A1A8 and equipment ground. This voltage should be -12.00 volts. If this voltage is not present, check the power distribution wiring (see figure 3-3).

d. Set the Detector function selector switch to AVERAGE, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the INPUT IMPEDANCE OHMS switch to 100K and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.

e. Measure the d-c voltages at transistors Q1 through Q4 of component board A1A8. (See figure 4-19 and table 4-17.) Replace any defective component.

f. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL.

g. Trace the 1-kHz calibration oscillator signal (using an oscilloscope) to locate any discontinuity within the average detector (CR9 through CR12 and associated circuitry of component board A1A8). Effect the necessary repairs and/or replacements.

h. Set the Detector function selector switch to RMS and trace the 1-kHz calibration oscillator signal (using the oscilloscope) to locate any discontinuity within the rms detector (CR1 through CR8 and Q1 through Q3 of component board A1A8). Effect the necessary repairs and/or replacements.

i. Set the Detector function selector switch to PEAK and trace the 1-kHz calibration oscillator signal (using the oscilloscope) to locate any discontinuity in the peak detector (Q4 and associated circuitry of component board A1A8). Effect the necessary repairs and/or replacements.

j. De-energize the Model NF-315 and replace component board A1A8 back into the i-f shelf.

k. Perform major steps 33, 34 and 35 of table 4-8 to ascertain that detector plug-in component board is operating properly.

l. Proceed to paragraph 4-34.

4-33. LOG AMPLIFIER A1A7, TROUBLESHOOTING. To troubleshoot this assembly, proceed as

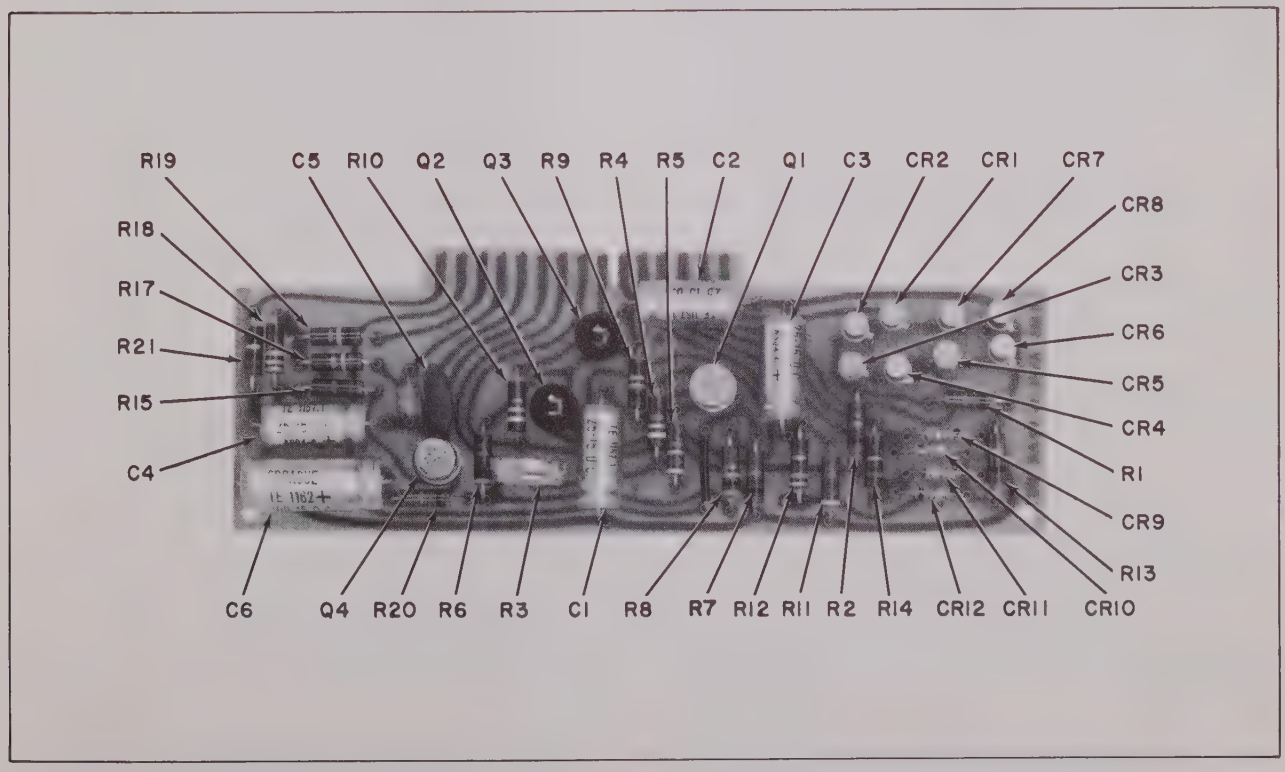


Figure 4-19. Detector Plug-in Component Board A1A8, Component Location Diagram

directed in the following steps. (See figure 4-2 to locate this assembly and figure 5-9 for its schematic diagram.)

a. With the Model NF-315 unenergized, withdraw log amplifier component board A7 from its slot in i-f shelf A1. Install the extender board into the vacated connector and mount the component board atop the extender board.

b. Energize the Model NF-315 and measure the voltage between terminal 13 of the component board and equipment ground. This voltage should be +12.00 volts. If this voltage is not present, check the power distribution wiring (see figure 3-3).

c. Measure the voltage between terminal 12 of the component board and equipment ground. This voltage should be -12.00 volts. If this voltage is not present, check the power distribution wiring (see figure 3-3).

d. Set the Detector function selector switch to AVERAGE, set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND and set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100.

e. With no signal source connected to the INPUT connector, measure the d-c voltages at transistors Q1 through Q6 of component board A1A7. (See figure 4-20 and table 4-18.) Effect the necessary repairs and/or replacements.

f. De-energize the Model NF-315 and proceed to paragraph 4-34.

4-34. LOG AMPLIFIER A1A7, CALIBRATION (METER AVG SCALE TRACKING). To calibrate this assembly, proceed as directed in the following steps.

a. With the Model NF-315 unenergized and component board A1A7 connected to the i-f shelf through the extender board, ground terminal 2 of the component board and connect a digital d-c vtvm between the base of A1A7Q5 and equipment ground.

b. Energize the Model NF-315 and adjust potentiometer R3 of component board A1A7 (see figure 4-20) to obtain a digital d-c vtvm indication between -0.5 and -1.2 volts.

c. Remove the short between terminal 2 of the component board and equipment ground and connect the digital d-c vtvm between terminal 2 and equipment ground.

d. Set the Detector function selector switch to AVERAGE, set the WIDE BAND SIG LEVEL CAL screwdriver control to mid-range, the BANDWIDTH SELECTOR switch to 250KHZ FIXED WIDE BAND and connect an oscillator (tuned to 1 kHz and adjusted for minimum output level) through a calibrated attenuator to J11 of i-f shelf A1 and a digital a-c vtvm. Set the calibrated attenuator for 20 dB insertion.

e. Adjust the oscillator output voltage to obtain a digital d-c vtvm indication of exactly 1.400 volts.

f. Adjust potentiometer R13 of component board A1A7 (see figure 4-20) to obtain a meter AVG scale indication of exactly 40 DB.

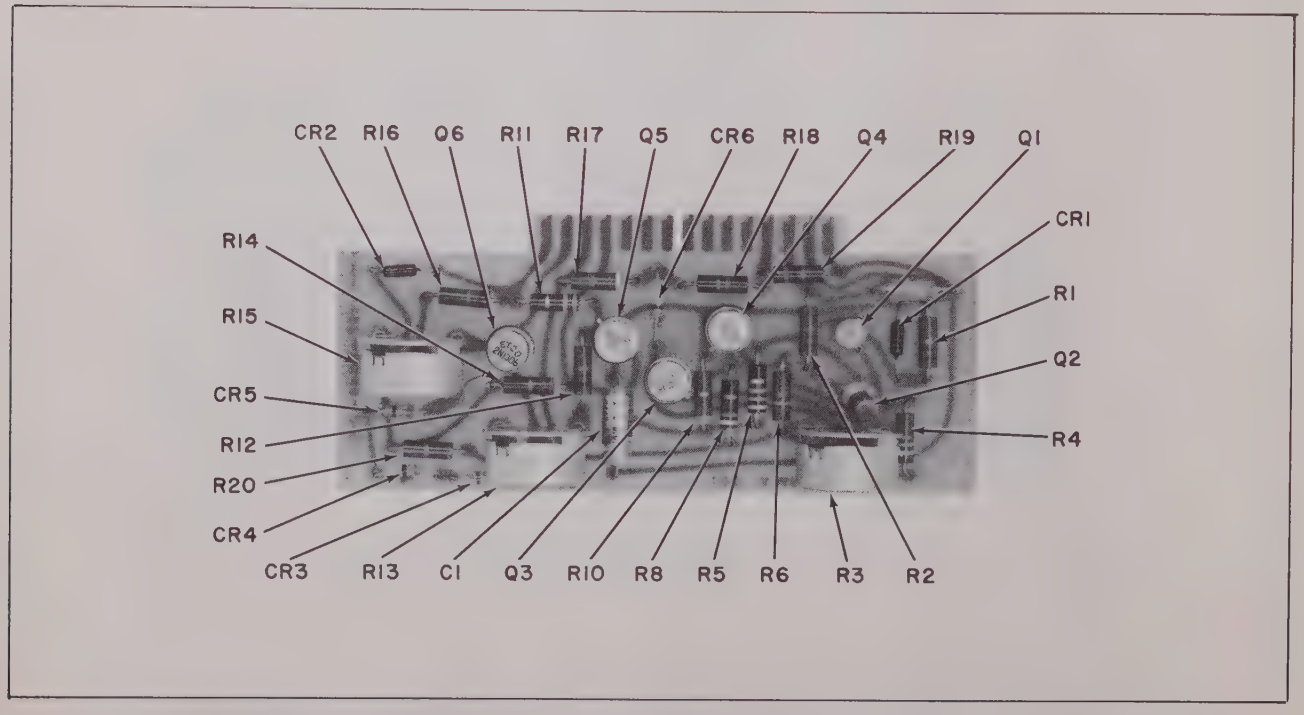


Figure 4-20. Log Amplifier Plug-in Component Board A1A7, Component Location Diagram

Note

It may be necessary to adjust potentiometer R15 of component board A1A7 (see figure 4-20) to obtain an on-scale meter indication.

g. Set the calibrated attenuator for 50 dB insertion and adjust the oscillator output level to obtain a digital d-c vtvm indication of exactly 0.0442 volts.

h. Adjust potentiometer R15 of component board A1A7 (see figure 4-20) to obtain a meter AVG scale indication of exactly 10 DB.

i. Repeat steps d through h until no further adjustments of potentiometers A1A7R13 and A1A7R15 are required to obtain the proper meter AVG scale indications.

j. De-energize the Model NF-315, disconnect the test equipment, connect the proper cable to J11 on i-f shelf A1.

k. Energize the Model NF-315, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL. The meter should read within 0.2 dB of CAL on the AVG scale. Adjust A2A1R6, if necessary, to obtain this indication. Proceed to paragraph 4-35.

4-35. METER RMS AND PEAK SCALE TRACKING. To track the meter RMS and PEAK scales, proceed as directed in the following steps (after first performing paragraph 4-34).

a. Set the Detector function selector switch to RMS, set the BANDWIDTH SELECTOR switch to 20KHZ FIXED WIDE BAND, set the INPUT IMPEDANCE OHMS switch to 100K, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100 and adjust the WIDE BAND SIG LEVEL CAL screwdriver control to mid-range.

b. With the Model NF-315 unenergized, withdraw detector plug-in component board A8 (see figure 4-2) from i-f shelf A1, insert the extender board into the vacated connector and mount the detector component board atop the extender board.

c. Connect an oscillator (through a calibrated attenuator) to both the INPUT connector and a digital a-c vtvm. Tune the oscillator to 1 kHz and adjust for minimum output level. Set the calibrated attenuator for 20 dB insertion.

d. Energize the Model NF-315 and adjust the oscillator output level to obtain a digital a-c vtvm indication of 316 millivolts rms.

e. Adjust potentiometer R12 of broadband driver amplifier component board A1A9 (see figure 4-18) to obtain a meter RMS scale indication of exactly 10 DB.

f. Disconnect the oscillator and associated test equipment from the INPUT connector and set the RMS 0 DB screwdriver control to mid-range.

g. De-energize the Model NF-315 and unsolder the lead at E19 of i-f shelf A1 (from RMS 0 DB screwdriver control R5).

h. Connect a digital d-c vtvm between terminal 7 of the withdrawn detector component board and equipment ground. Short both terminals 2 and 3 of the withdrawn detector board to equipment ground.

i. Energize the Model NF-315 and adjust potentiometer R3 on detector board A1A8 (see figure 4-19) to obtain a digital d-c vtvm indication of 0 ±1 millivolt.

j. De-energize the Model NF-315, remove the shorts from between terminals 2 and 3 of the withdrawn detector board and equipment ground and disconnect the digital d-c vtvm.

k. Reconnect the oscillator, calibrated attenuator and digital a-c vtvm to the INPUT connector and adjust the oscillator to obtain a digital a-c vtvm indication of 316 millivolts rms (at 1 kHz).

l. Energize the Model NF-315 and note the meter RMS scale indication - - it should read 10 DB. If it does not, re-adjust R12 of the broadband driver amplifier (see figure 4-18) to obtain a meter RMS scale indication of 10 DB.

m. De-energize the Model NF-315 and resolder the lead from RMS 0 DB screwdriver control R5 to E19 of i-f shelf A1.

n. Connect the digital d-c vtvm between E19 of i-f shelf A1 and equipment ground. Energize the Model NF-315 and set the RMS 0 DB screwdriver control first fully clockwise and then fully counterclockwise. Note the digital d-c vtvm indication for each setting of the RMS 0 DB screwdriver control. This voltage should be adjustable from at least +10 to -10 millivolts. Set for 0±1 millivolt.

o. Set the Detector function selector switch to PEAK.

p. Set the calibrated attenuator for 0 dB insertion and adjust the oscillator output level to obtain a digital a-c vtvm indication of 3.535 volts rms.

q. Adjust potentiometer R9 on the broadband driver amplifier (see figure 4-18) to obtain a meter PEAK scale indication of exactly CAL.

r. Set the Detector function selector switch to AVERAGE.

s. Adjust the oscillator output level to obtain a digital a-c vtvm indication of 3.51 volts rms.

t. Set the WIDE BAND SIG LEVEL CAL screwdriver control to obtain a meter AVG scale indication of exactly CAL.

u. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL.

v. Carefully adjust potentiometer R6 of attenuator and 1-kHz calibration oscillator A2 (accessible through a hole in the top of A2) to obtain a meter AVG scale indication of exactly CAL.

w. De-energize and disconnect the equipment. Replace A8 back into the i-f shelf.

4-36. OBTAINING NEW CALIBRATION CURVE. If any adjustment and/or repair has been made in the input, narrow band or output sections, obtain a new 100,000-ohm input impedance calibration curve for the 70-Hz and 7-Hz tunable narrow band modes as directed in the following steps.

a. With the Model NF-315 unenergized, connect an oscillator (terminated in a precision 600-ohm resistor) to both the INPUT connector and a digital a-c vtvm. Tune the oscillator to 1 kHz and adjust for minimum output level.

b. Energize the Model NF-315 and balance the modulator as described in paragraph 2-34. After the modulator is balanced, continue to step c.

c. Set the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100.

d. Adjust the oscillator output level to obtain a digital a-c vtvm indication of exactly 3.51 volts rms.

e. Carefully adjust the FREQUENCY TUNING control to obtain a maximum meter AVG scale indication.

f. Carefully adjust the NARROW BAND SIG LEVEL CAL screwdriver control to obtain a meter AVG scale indication of exactly CAL.

g. Tune the oscillator, in sequence, to each of the frequencies listed below. At each frequency carefully adjust the FREQUENCY TUNING control to obtain a maximum meter AVG scale indication, adjust the oscillator output level to obtain a meter AVG scale indication of exactly CAL and note and record the digital a-c vtvm indication.

Frequencies: 22 Hz, 100 Hz, 200 Hz, 3 kHz, 5 kHz, 7 kHz, 9 kHz, 11 kHz, 13 kHz and 15 kHz

h. Compute the dB difference between each of the oscillator output levels with respect to 3.51 volts rms. Plot these points as illustrated in figure 2-5c.

Note

If the oscillator output level at a particular frequency is above 3.51 volts rms, the computed dB difference should be plotted as a minus dB point. Conversely, if the oscillator output level is below 3.51 volts rms, the computed dB difference should be plotted as a plus dB point.

i. De-energize and disconnect the equipment.

4-37. AUDIO AMPLIFIER AND BFO/MIXER A3A1, TROUBLESHOOTING. To troubleshoot this assembly, proceed as directed in the following steps. (See figure 4-4 to locate this assembly and figure 5-12 for its schematic diagram.)

a. With the Model NF-315 unenergized, withdraw the component board from its slot in the audio/bfo assembly, install the extender board and mount the component board atop the extender board.

b. Energize the Model NF-315

c. Set the Detector function selector switch to AVERAGE, the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND, the INPUT IMPEDANCE OHMS switch to 100K, the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of 100, the NARROW BAND attenuator switch to obtain a NARROW BAND dB dial indication of 100 and set the BFO switch to ON.

d. Plug a 600-ohm headset into the PHONES connector.

e. Measure the voltage between terminal 3 of the withdrawn component board and equipment ground. This voltage should be -12.7 volts (nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

f. Check the d-c voltages at transistors Q1 and Q2 of the component board. (See figure 4-21 and table 4-19.) Replace any defective component.

g. Set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and adjust the FREQUENCY TUNING control to obtain a maximum meter pointer deflection.

h. Trace the signal, using an oscilloscope, to locate any discontinuity. Effect the necessary repairs and/or replacements.

i. De-energize the Model NF-315 and replace the component board back into the audio/bfo assembly.

4-38. AUDIO AMPLIFIER A3A2, TROUBLESHOOTING. To troubleshoot this assembly, proceed as directed in the following steps. (See figure 4-4 to locate this assembly and figure 5-13 for its schematic diagram.)

a. With the Model NF-315 unenergized, withdraw the audio amplifier component board from its slot in the audio/bfo assembly. Install the extender board into the vacated connector and mount the component board atop the extender board.

b. Energize the Model NF-315.

c. Set the Detector function selector switch to AVERAGE, set the INPUT IMPEDANCE OHMS switch to 100K, set the BANDWIDTH SELECTOR switch to

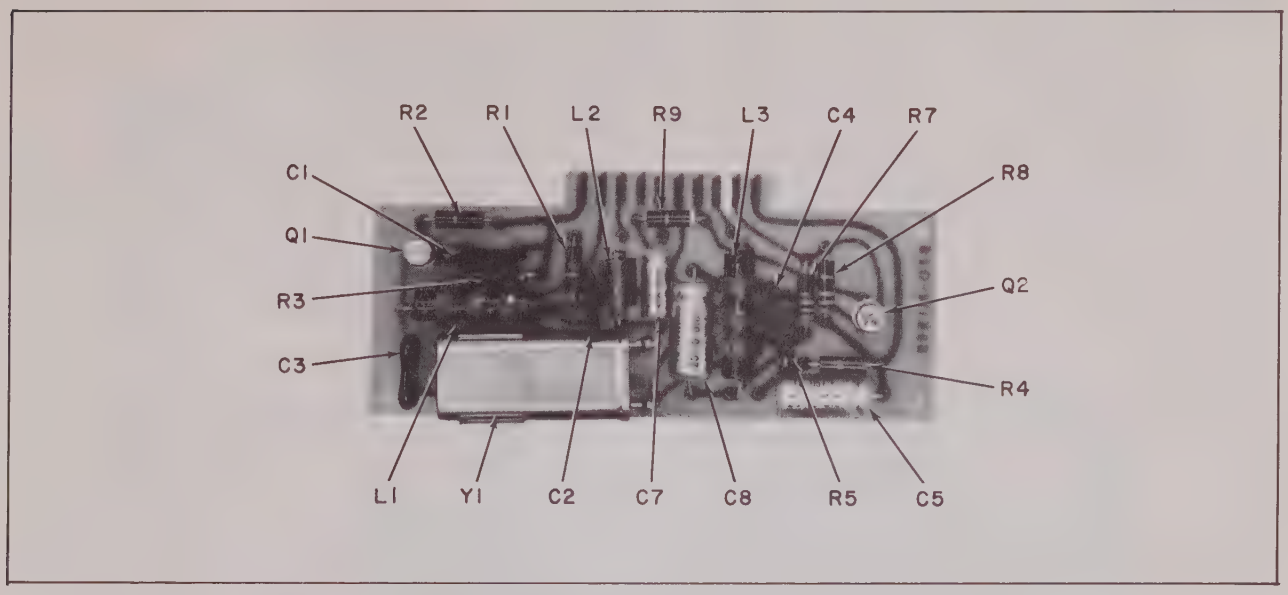


Figure 4-21. Audio Amplifier and BFO/Mixer Plug-in Component Board A3A1, Component Location Diagram

20KHZ FIXED WIDE BAND, set the WIDE BAND attenuator switch to obtain a WIDE BAND dB dial indication of CAL and set the BFO switch to OFF.

d. Plug a 600-ohm headset into the PHONES connector and measure the voltage between terminal 3 of the component board and equipment ground - - this voltage should be +12.7 volts (nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

e. Measure the voltage between terminal 5 of the component board and equipment ground - - this voltage should be -12.7 volts (nominal). If this voltage is not present, check the power distribution wiring (see figure 3-3).

f. Check the d-c voltages at transistors Q1 through Q3 of the component board. (See figure 4-22 and table 4-20.) Replace any defective component.

g. De-energize the equipment and replace the component board back into the audio/bfo assembly.

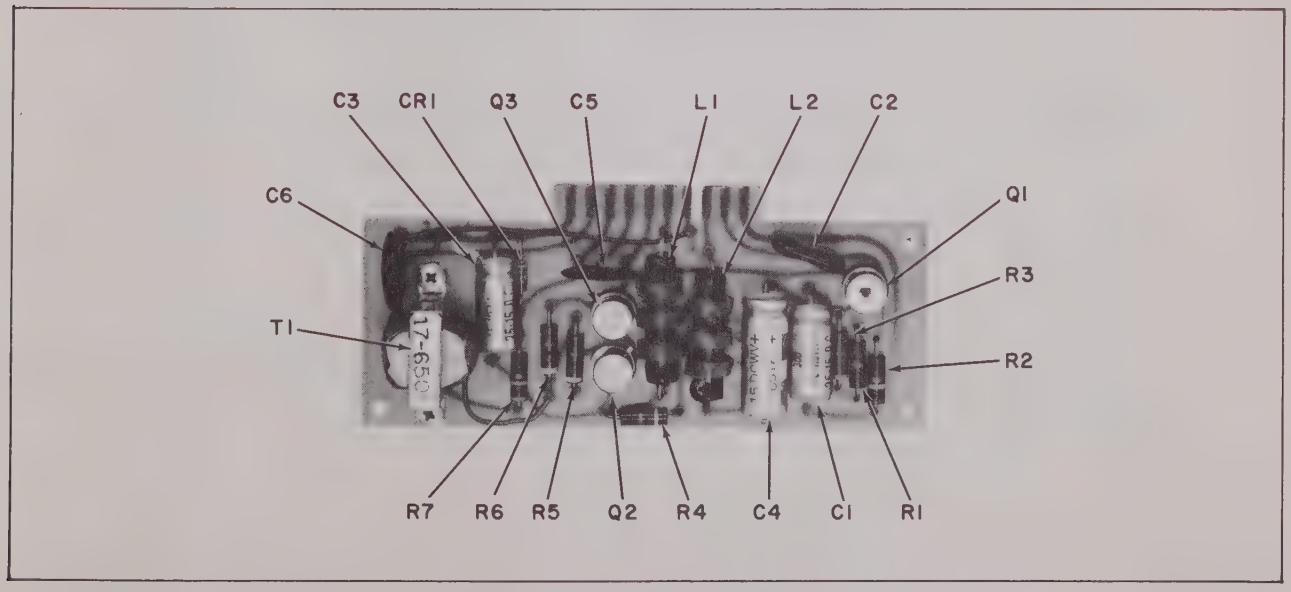


Figure 4-22. Audio Amplifier Plug-in Component Board A3A2, Component Location Diagram

TABLE 4-7. VOLTAGE MEASUREMENTS, VOLTAGE REGULATOR A6

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N242	-12.7	-13.0	-18
Q2	2N242	-21	-21.4	-30
Q3	2N242	+25.4	+25	+18
Q4	2N1483	+12.7	+13.0	+18
A1Q1	2N404	-13	-13.7	-18
A1Q2	2N404	-6	-5.7	-13.4
A1Q3	2N1302	+13.0	+13.3	+18
A1Q4	2N1302	+6	+6.3	+13.3

See Notes 1 and 2 following table 4-20.

TABLE 4-8. VOLTAGE MEASUREMENTS, DETECTOR LINE FILTER A1A1

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N1302	+12.7	+13	+18
Q2	2N404	-12.7	-13	-18

See Notes 1 and 2 following table 4-20.

TABLE 4-9. VOLTAGE MEASUREMENTS, 20-KHZ LOW-PASS FILTER AND BROADBAND LOW-NOISE PREAMPLIFIER A1A10

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N2386	-0.1 (SOURCE)	0 (GATE)	-9 (DRAIN)
Q2	A307	-9.8	-9	-2
Q3	A307	-2.4	-2	+9.8
Q4	2N404	0	-0.2	-7
Q5	2N1306	0	+0.2	+7

See Note 1 following table 4-20.

TABLE 4-10. VOLTAGE MEASUREMENTS, 1-KHZ CALIBRATION OSCILLATOR A2A1

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N404	-0.7V	-1V	-12.7

See Note 1 following table 4-20.

TABLE 4-11. VOLTAGE MEASUREMENTS, WIDE BAND AMPLIFIER A1A11

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N2188	+0.25	0	-12.7
Q2	2N2188	+0.45	+0.25	-9
Q3	2N1302	-9.2	-9	0
Q4	2N404	+0.1	0	-12.7
Q5	2N404	+0.1	0	-12.7

See Notes 1, 3 and 4 following table 4-20.

TABLE 4-12. VOLTAGE MEASUREMENTS, TUNABLE LOCAL OSCILLATOR A5A1

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N2188	0	0	-12.7
Q2	2N1302	-7	-6.6	+3.6
Q3	2N404	+3.9	+3.8	-6.1
Q4	2N1302	-6.3	-6.1	+12.7
Q5	2N1306	+0.3	0	+12.7
Q6	2N404	-6	-4.2	-8
Q7	2N1306	+0.3	0	+12.7

See Note 1 following table 4-20.

TABLE 4-13. VOLTAGE MEASUREMENTS, INPUT CRYSTAL FILTER A1A2

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	A307	+6	+6.3	+12.7
Q2	A1380	+5.7	+6	+12.7
Q3	2N404	+6	+6.3	0
Q4	2N404	+6	+6.3	0

See Note 1 following table 4-20.

TABLE 4-14. VOLTAGE MEASUREMENTS, 100-KHZ I-F AMPLIFIERS A1A4 AND A1A6

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N2188	-0.7	-1	-12.7
Q2	2N2188	-0.4	-0.7	-12.7
Q3	2N2188	-0.7	-1	-5
Q4	2N2188	-4.7	-5	-7.2

See Notes 1 and 5 following table 4-20.

TABLE 4-15. VOLTAGE MEASUREMENTS, 100-KHZ I-F CRYSTAL FILTERS A1A3 AND A1A5

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N404	-6	-6.3	-12.7
Q2	2N404	-5.7	-6	-12.7

See Notes 1 and 5 following table 4-20.

TABLE 4-16. VOLTAGE MEASUREMENTS, BROADBAND DRIVER AMPLIFIER A1A9

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	A1380	-7.5	-7.0	+12
Q2	2N2188	-6.7	-7.0	-9
Q3	2N1302	-9.2	-9	0
Q4	2N1302	+0.1	+0.2	+8.7
Q5	2N404	+9.0	+8.8	-1.7

See Notes 1 and 3 following table 4-20.

TABLE 4-16. VOLTAGE MEASUREMENTS, BROADBAND DRIVER AMPLIFIER A1A9 (Cont'd)

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q6	2N404	+9.0	+8.7	+4.0
Q7	2N404	-1.3	-1.7	-12
Q8	2N1306	-0.1	+0.1	+12
Q9	2N404	+0.3	-0.1	-12

See Notes 1 and 3 following table 4-20.

TABLE 4-17. VOLTAGE MEASUREMENTS, DETECTOR A1A8

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1 (Note 7)	SM8553	A- +7.8 B- +7.8	A- 0 B- 0	A- +8 B- +8
Q2 (Note 7)	2N3638	+9	+8	0
Q3 (Note 7)	2N3638	+9	+8	0
Q4 (Note 7)	2N1302	+0.1	+0.05	+12

See Notes 1, 6 and 7 following table 4-20.

TABLE 4-18. VOLTAGE MEASUREMENTS, LOG AMPLIFIER A1A7

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	A1380	-0.6	0	+8.2
Q2	A1380	-0.6	0	+8.2
Q3	2N1303	+9.3	+9	0
Q4	2N1303	+9.3	+9	-0 to -5
Q5	2N404	-0.3 to -5.3	0 to -5	+12
Q6	2N1306	-3.3	-3	+12

See Note 1 following table 4-20.

TABLE 4-19. VOLTAGE MEASUREMENTS, AUDIO AMPLIFIER AND BFO/MIXER A3A1

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N2188	-4.3	-1	-8
Q2	2N2188	-2.7	-3	-12.7

See Notes 1, 8 and 9 following table 4-20.

TABLE 4-20. VOLTAGE MEASUREMENTS, AUDIO AMPLIFIER A3A2

Transistor Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N404	+2.7	+2	0
Q2	SM4645	-0.5	0	-12.7
Q3	2N696	+0.5	0	+12.7

See Notes 1, 9 and 10 following table 4-20.

Notes:

1. All measurements made with respect to equipment ground with a 20,000 ohm/volt voltmeter.
2. POWER selector switch set to AC OPERATE.
3. BANDWIDTH SELECTOR switch set to 20KHZ FIXED WIDE BAND.
4. WIDE BAND SIG LEVEL CAL screwdriver control set to mid range.
5. BANDWIDTH SELECTOR switch set to 70HZ TUNABLE NARROW BAND.
6. Detector function selector switch set to PEAK.
7. RMS 0DB screwdriver control set to mid range.
8. BFO switch set to ON.
9. 600-ohm headset plugged into PHONES connector.
10. BFO switch set to OFF.

4-39. TRACKING ANALOG X OUTPUT VOLTAGE. To track the analog x output voltage, proceed as directed in the following steps.

a. With the Model NF-315 unenergized, remove the four screws that secure the cover of tunable local oscillator board A5A1 to A5. Remove the cover.

b. Connect a digital voltmeter between pins D and F of the REMOTE INDICATOR connector.

c. Set the BANDWIDTH SELECTOR switch to 70HZ TUNABLE NARROW BAND and energize the Model NF-315.

d. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 00000. Note the voltmeter indication - it should read within $\pm$0.5 volts of 0. If it does not, adjust A5A1R23 to obtain the proper voltage. (Note that for optimum recording accuracy, adjust A5A1R23 for a voltmeter indication of 0 volts.)

e. Adjust the FREQUENCY TUNING control to obtain a FREQUENCY 20HZ-15KHZ counter indication of 15000. Note the voltmeter indication - it should read within $\pm$0.5 volts of +10 volts. If it does not, adjust A5A1R24 to obtain the proper voltage. (Note that for optimum recording accuracy, adjust A5A1R24 for a voltmeter indication of +10 volts.)

f. Repeat steps d and e until no further adjustment of either control is required to obtain the proper voltages.

g. De-energize the Model NF-315, disconnect the voltmeter and replace the cover to A5.

SECTION V
SCHEMATIC DIAGRAMS

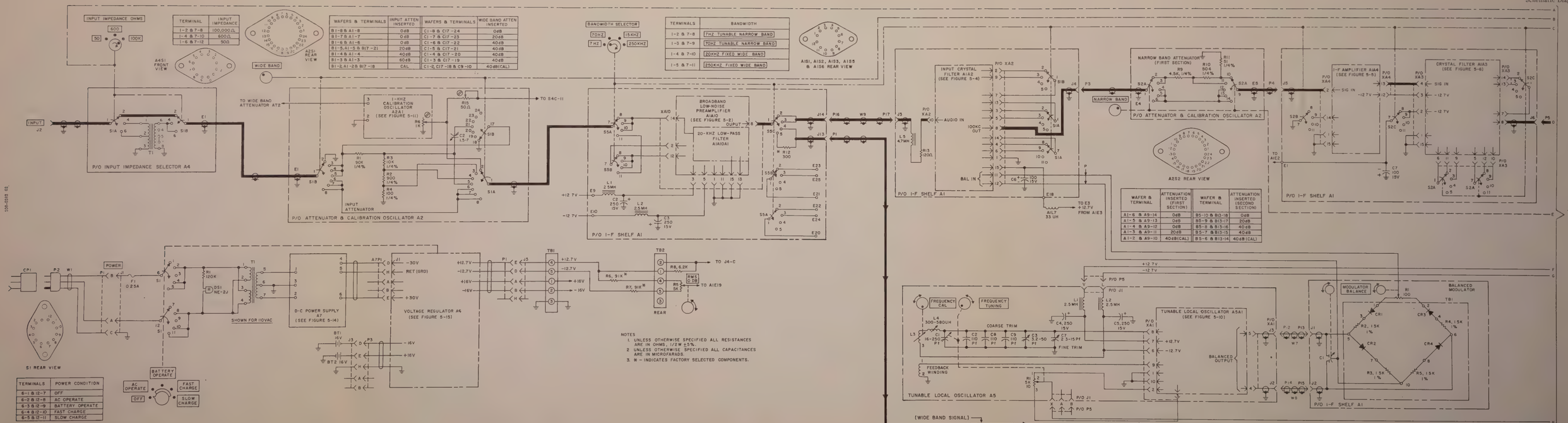


Figure 5-1. Model NF-315 Noise and Field Intensity Meter, Interassembly Connection Diagram (Sheet 1 of 2)

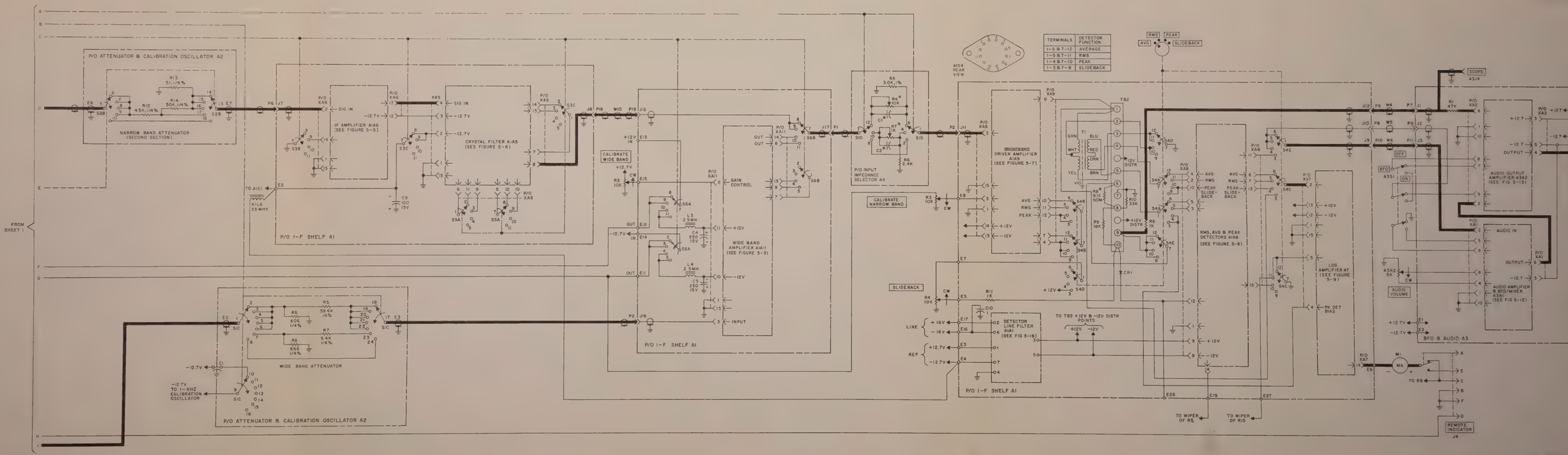
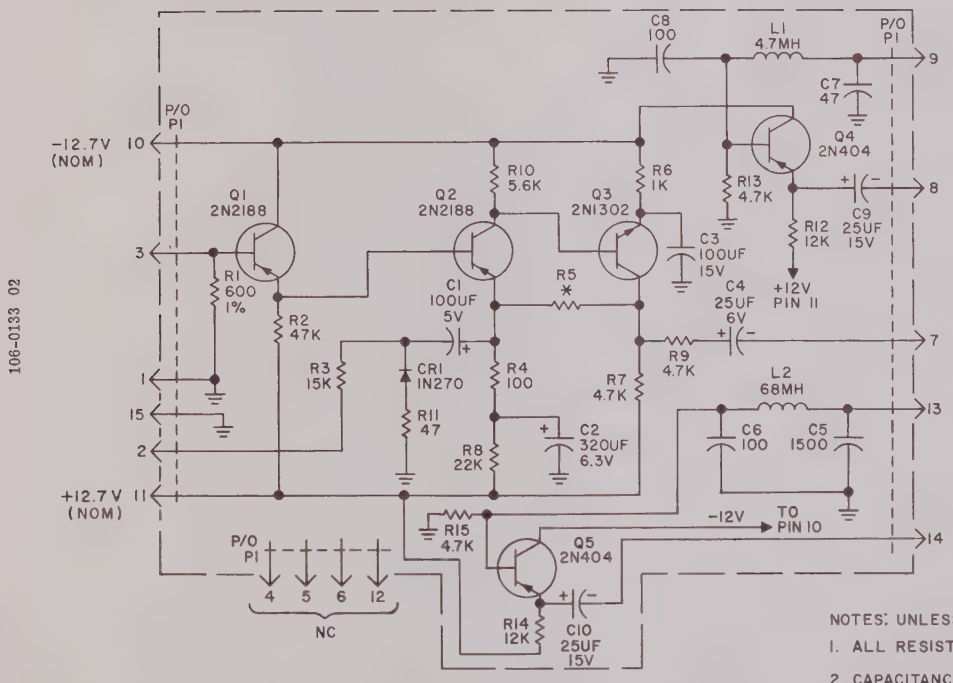

P/O ATTENUATOR & CALIBRATION OSCILLATOR A2
NARROW BAND ATTENUATOR (SECOND SECTION)
WIDE BAND ATTENUATOR
P/O ATTENUATOR & CALIBRATION OSCILLATOR A2
-12.7V TO 1-KHZ CALIBRATION OSCILLATOR
IF AMPLIFIER A1A6 (SEE FIGURE 5-5)
CRYSTAL FILTER A1A5 (SEE FIGURE 5-6)
TO A1E1
A1L6 33 MHY
P/O 1-F SHELF A1
CALIBRATE WIDE BAND
CALIBRATE NARROW BAND
GAIN CONTROL
WIDE BAND AMPLIFIER A1A11 (SEE FIGURE 5-3)
P/O 1-F SHELF A1
P/O INPUT IMPEDANCE SELECTOR A4
A1S4 REAR VIEW
TERMINALS | DETECTOR FUNCTION
1-6 & 7-12 AVERAGE
1-5 & 7-11 RMS
1-4 & 7-10 PEAK
1-3 & 7-9 SLIDEBACK
RMS
PEAK
AVG
SLIDEBACK
BROADBAND DRIVER AMPLIFIER A1A9 (SEE FIGURE 5-7)
DETECTOR LINE FILTER A1A1 (SEE FIG 5-16)
TO TB2 +12V & -12V DISTR POINTS
P/O 1-F SHELF A1
RMS, AVG & PEAK DETECTORS A1A8 (SEE FIGURE 5-8)
LOG AMPLIFIER A7 (SEE FIGURE 5-9)
PK DET BIAS
TO WIPER OF R5
TO WIPER OF R15
SCOPE A3J4
AUDIO OUTPUT AMPLIFIER A3A2 (SEE FIG 5-13)
PHONES A3J5
OFF
BFO ON A3S1
AUDIO IN
AUDIO VOLUME A3R2 5K
AUDIO AMPLIFIER & BFO/MIXER A3A1 (SEE FIG 5-12)
BFO & AUDIO A3
TO R8
REMOTE INDICATOR J4
FROM SHEET 1

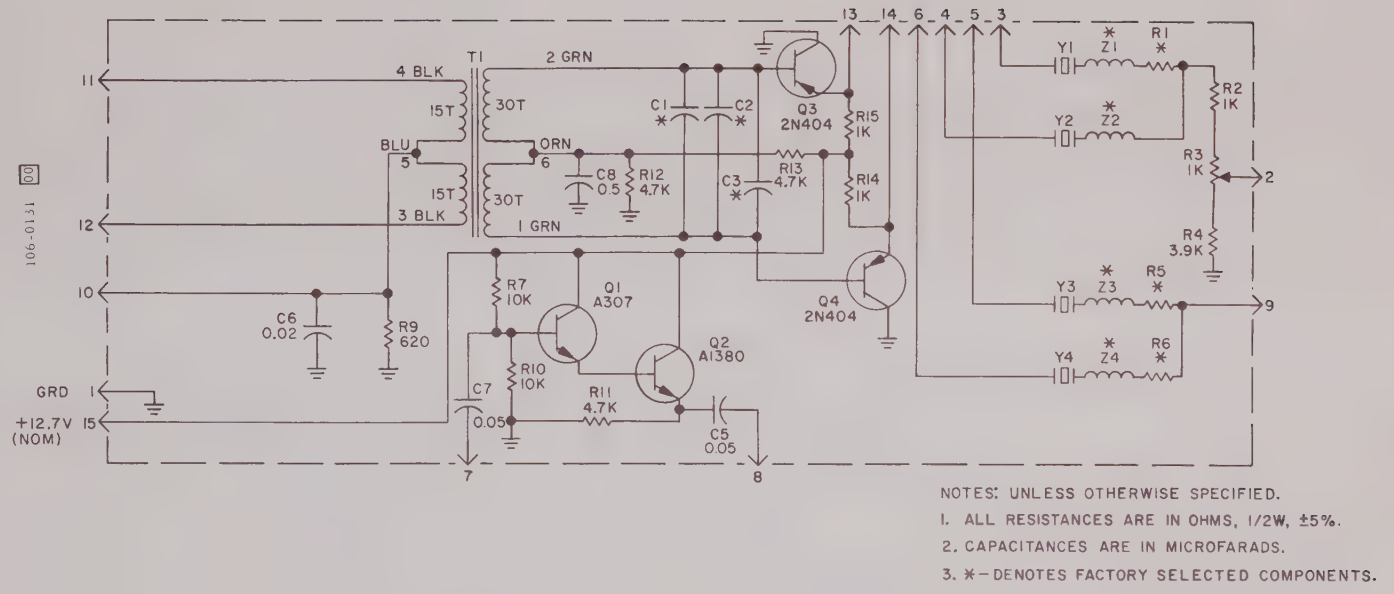
Figure 5-1. Model NF-315 Noise and Field Intensity Meter, Interassembly Connection Diagram (Sheet 2 of 2)



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCES ARE IN OHMS, 1/2W, ±5%.
2. CAPACITANCES ARE IN PICOFARADS.
3. * TO BE FACTORY SELECTED

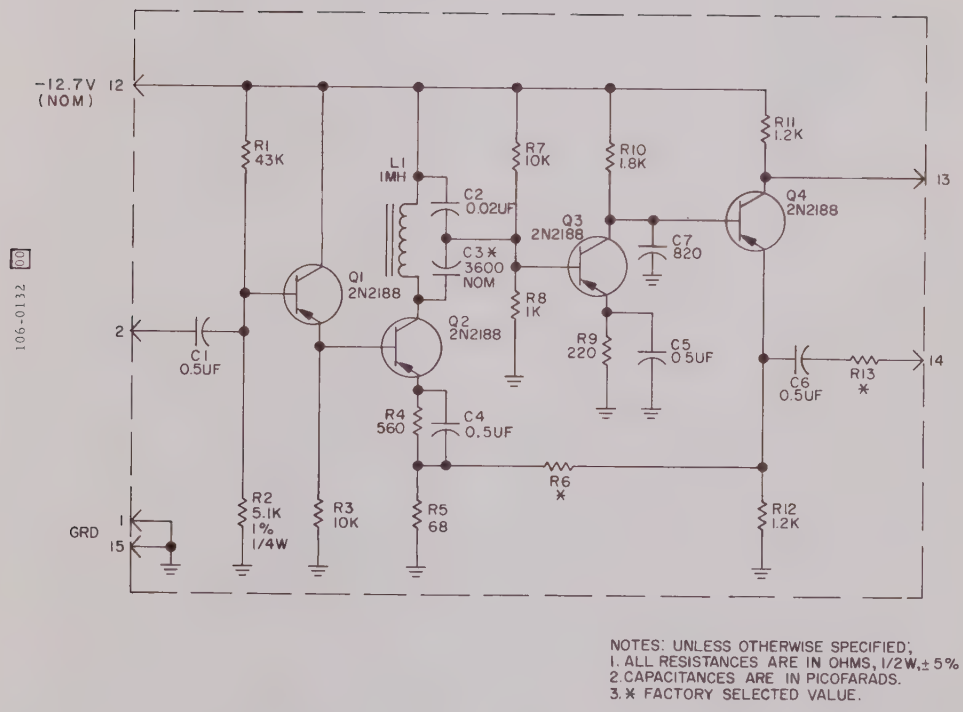
Figure 5-3. Wide Band Amplifier Plug-in Component Board A1A11, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED.

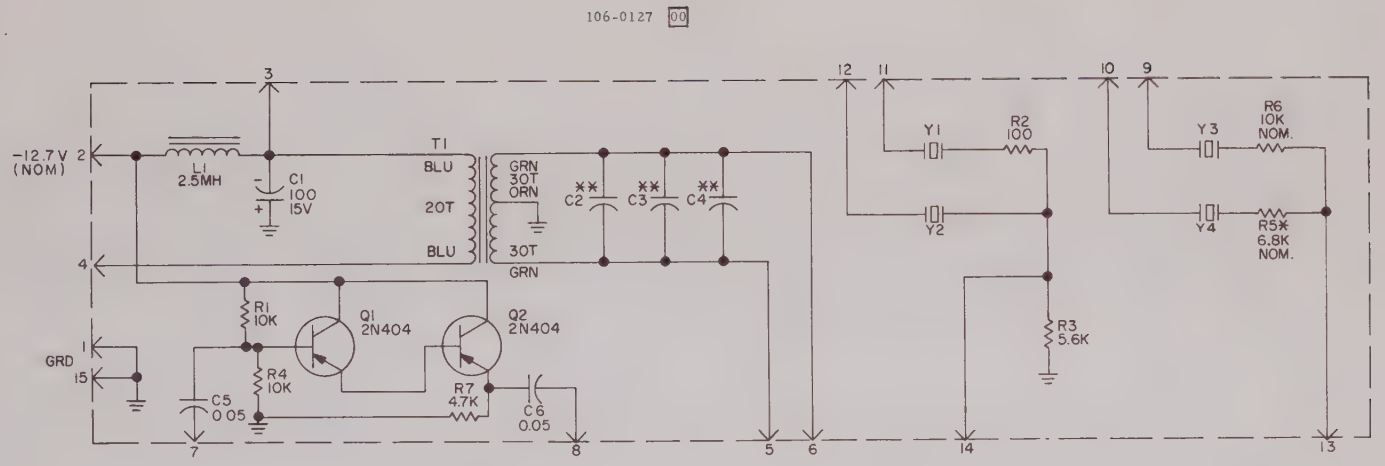
1. ALL RESISTANCES ARE IN OHMS, 1/2W, ±5%.
2. CAPACITANCES ARE IN MICROFARADS.
3. *—DENOTES FACTORY SELECTED COMPONENTS.

Figure 5-4. Input Crystal Filter Plug-in Component Board A1A2, Schematic Diagram



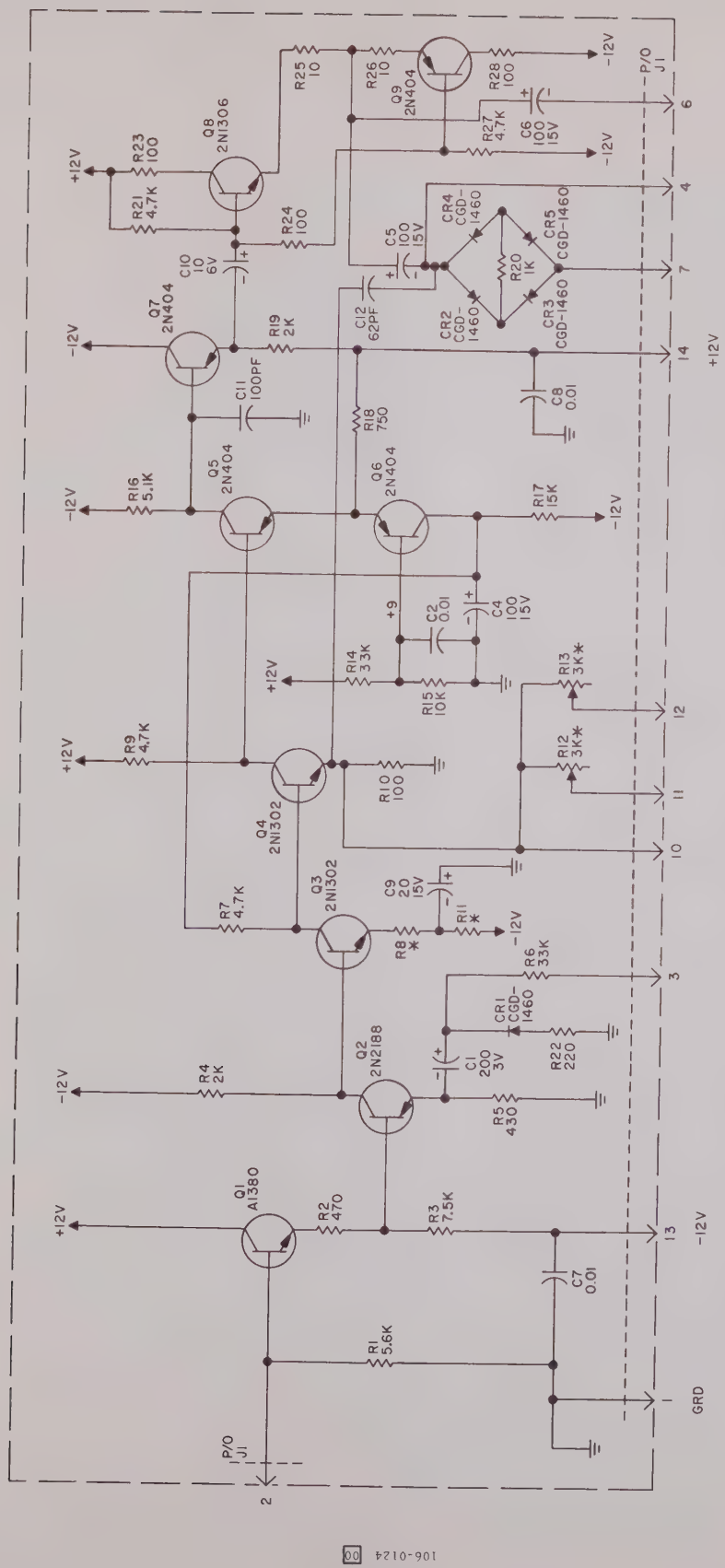
NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTANCES ARE IN OHMS, 1/2W, ± 5%
2. CAPACITANCES ARE IN PICOFARADS.
3. * FACTORY SELECTED VALUE.

Figure 5-5. 100-kHz I-f Amplifier Plug-in Component Boards A1A4 and A1A6, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTANCES ARE IN OMMS. 1/2 W, 5%.
2. CAPACITANCES ARE IN MICROFARADS.
3. * INDICATES FACTORY SELECTED COMPONENT
4. ** INDICATES FACTORY SELECTED COMPONENTS (C2, C3 AND C4) TOTALING 700 TO 1200 PF.

Figure 5-6. 100-kHz I-f Crystal Filter Plug-in Component Boards A1A3 and A1A5, Schematic Diagram

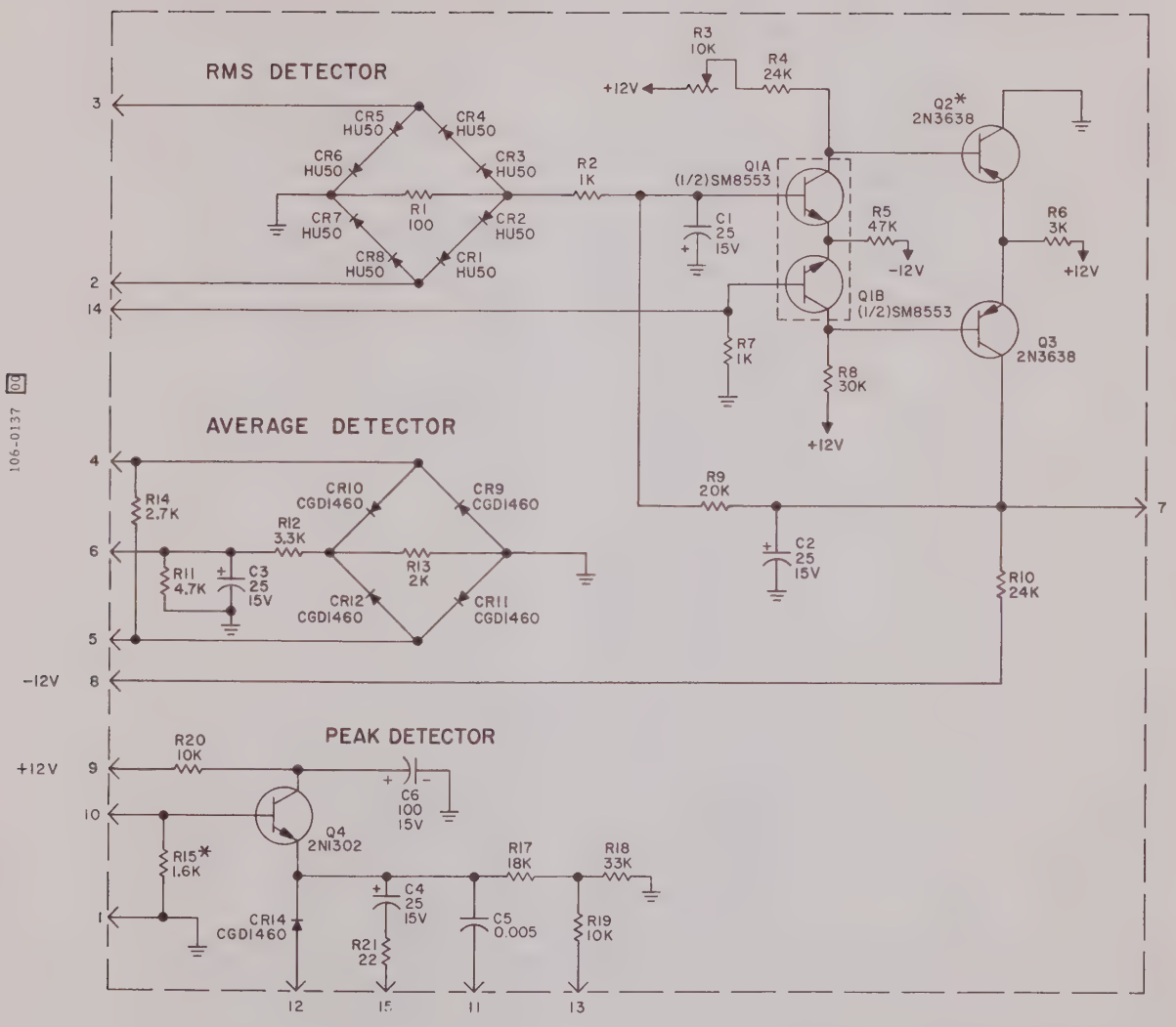


NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL RESISTANCES ARE IN OHMS, 1/2 WATT, ±5%.
2. ALL CAPACITANCES ARE IN MICROFARADS.
3. * ON SOME UNITS THIS VALUE IS IK.
4. **-FACTORY SELECT. THE SUM OF R8 AND R11 MUST BE 4.6K ±400 OHMS.

106-0124 00

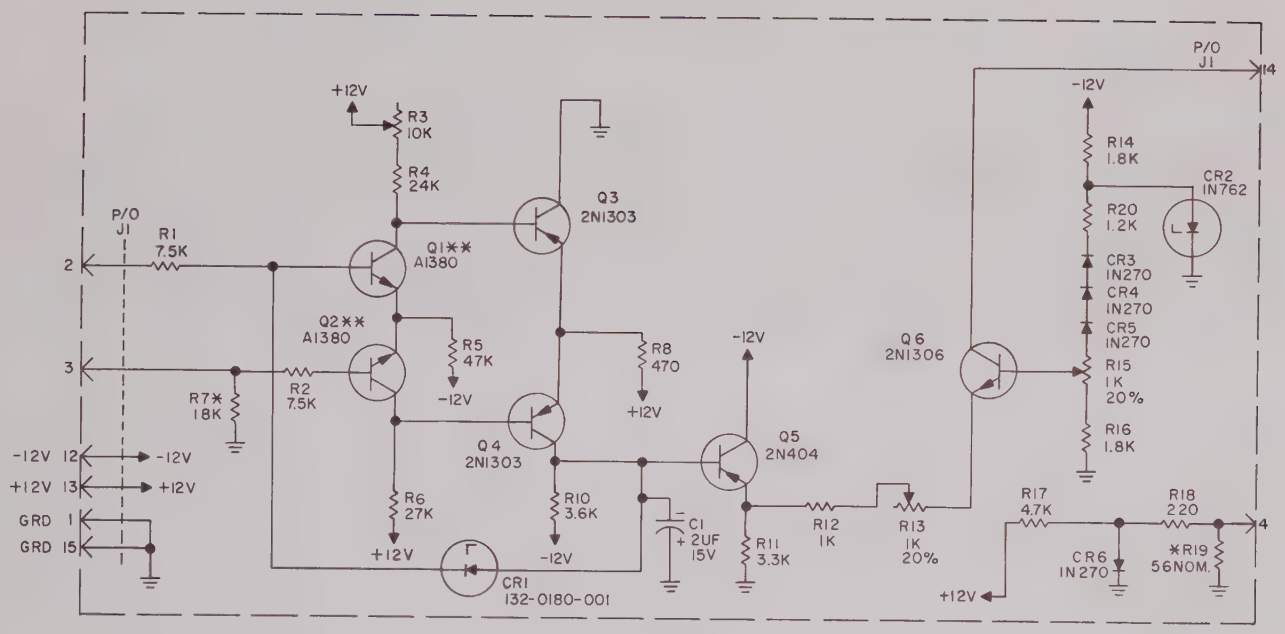
Figure 5-7. Broadband Driver Amplifier Plug-in Component Board A1A9, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED.

1. RESISTANCES ARE IN OHMS, 1/2W, ±5%.
2. CAPACITANCES ARE IN MICROFARADS.
3. * FACTORY SELECTED.

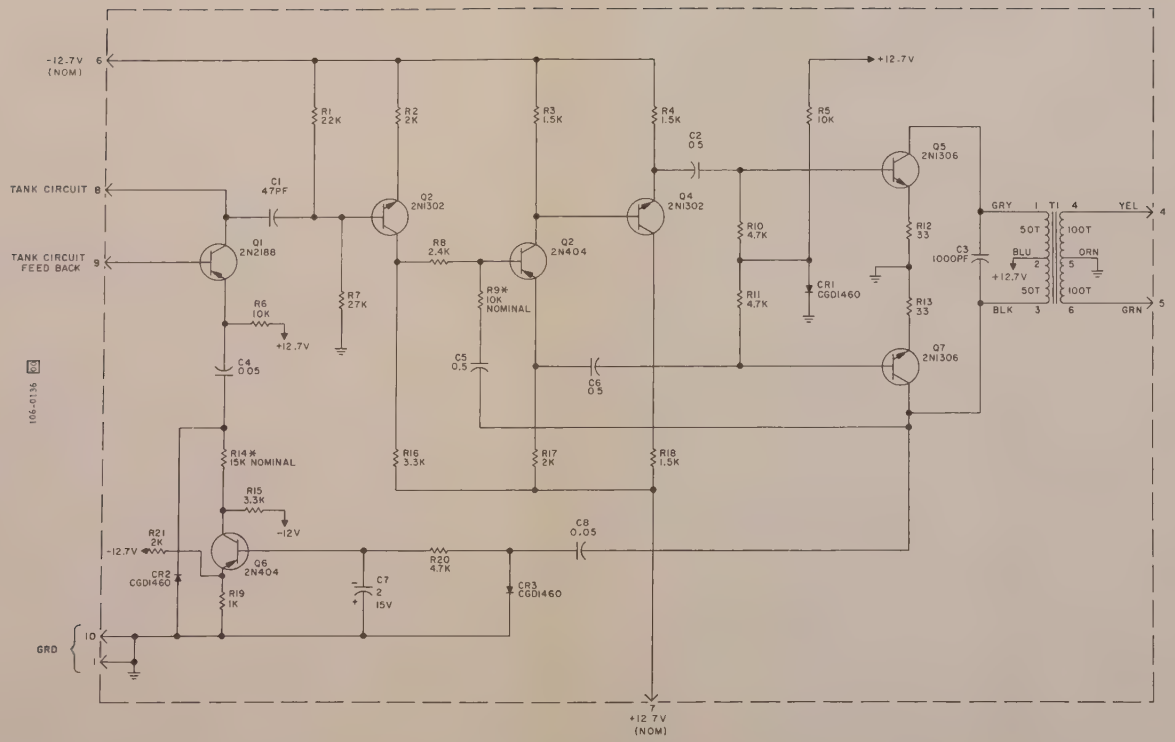
Figure 5-8. Detector Plug-in Component Board A1A8, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED -

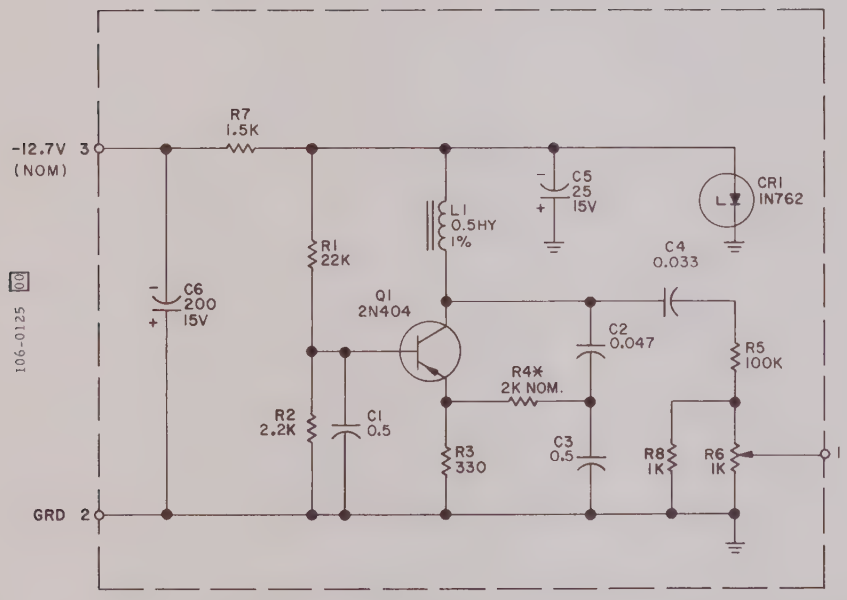
1. ALL RESISTANCES ARE IN OHMS, 1/2W ±5%
2. * INDICATES - FACTORY SELECT.
3. ** INDICATES - IT MAY BE NECESSARY TO SELECT TRANSISTORS Q1 AND Q2 FOR PROPER BALANCE DURING INITIAL ALIGNMENT

Figure 5-9. Log Amplifier Plug-in Component Board A1A7, Schematic Diagram



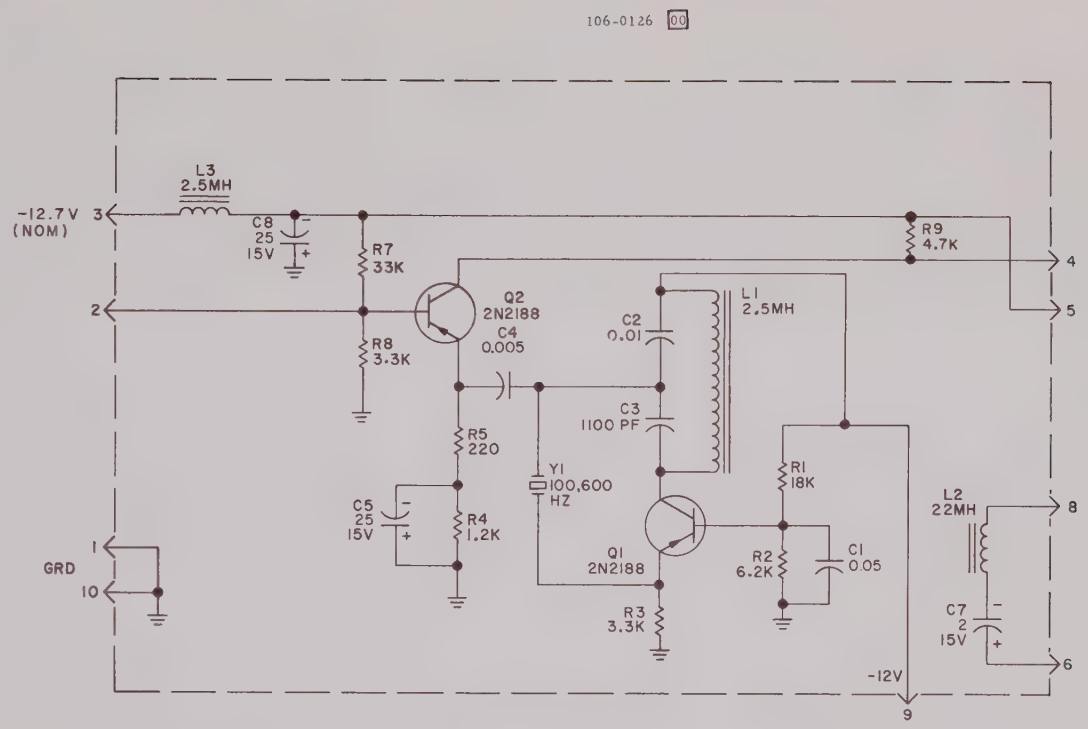
NOTES. UNLESS OTHERWISE SPECIFIED.
1 ALL RESISTANCES ARE IN OHMS, 1/2W, ±5%.
2 ALL CAPACITANCES ARE IN MICROFARADS.
3. * FACTORY SELECTED VALUE

Figure 5-10. Tunable Local Oscillator Plug-in Component Board A5A1, Schematic Diagram



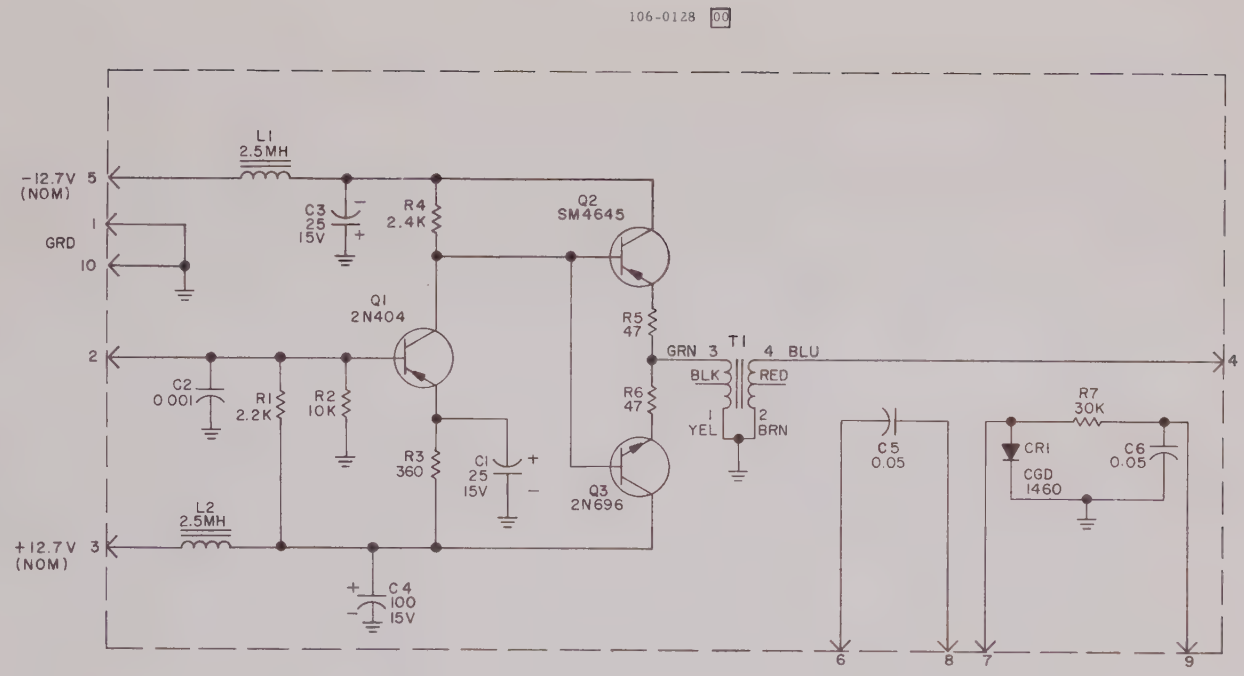
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCES ARE IN OHMS, 1/2W ±5%.
2. * INDICATES FACTORY SELECTED COMPONENTS.
3. ALL CAPACITORS ARE IN MICROFARADS

Figure 5-11. 1-kHz Calibration Oscillator Component Board A2A1, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCES ARE IN OHMS, 1/2W, 5%.
2. CAPACITANCES ARE IN MICROFARADS.

Figure 5-12. Audio Amplifier and BFO/Mixer Plug-in Component Board A3A1, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTANCES ARE IN OHMS 1/2W.5%
2. ALL CAPACITOR ARE IN MICROFARADS

Figure 5-13. Audio Amplifier Plug-in Component Board A3A2, Schematic Diagram

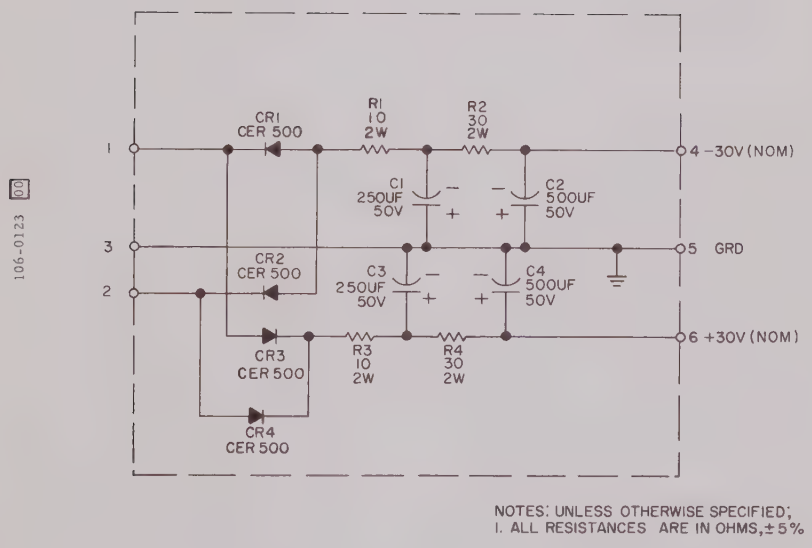


Figure 5-14. D-c Power Supply Component Board A7, Schematic Diagram

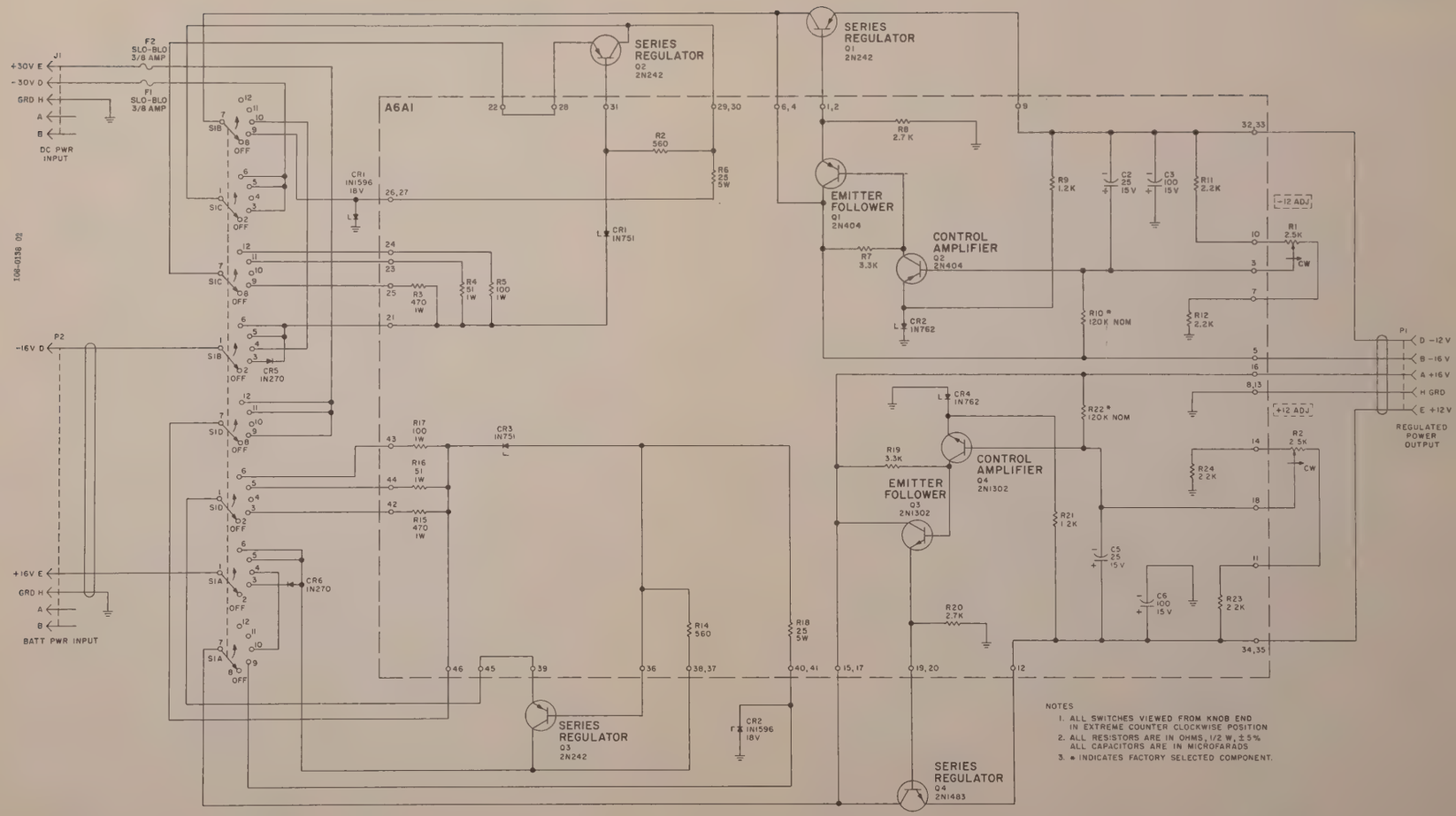
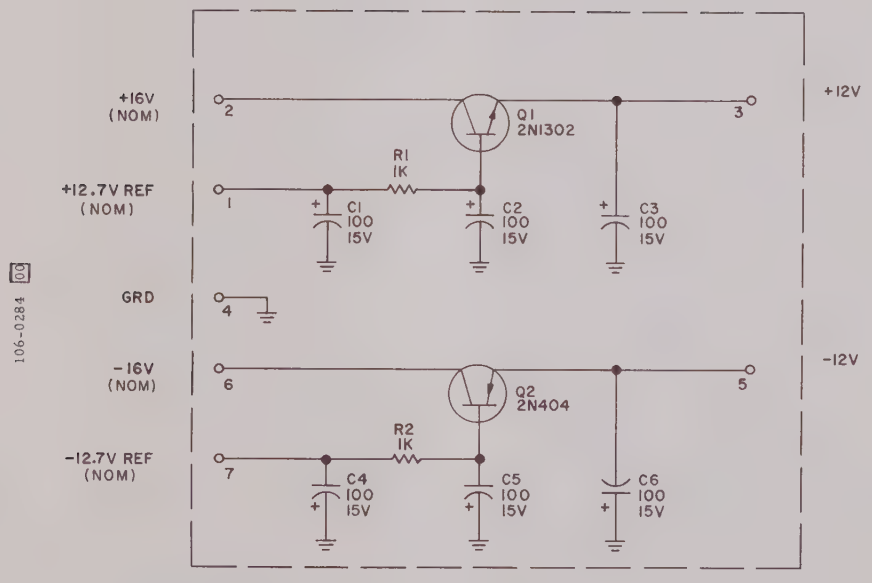


Figure 5-15. Voltage Regulator A6, Schematic Diagram



NOTES:
1. ALL CAPACITANCES ARE IN MICROFARADS
2. ALL RESISTANCES ARE IN OHMS, 1/2W, ±5%
3. Q1 AND Q2 MUST HAVE HEAT SINKS

Figure 5-16. Detector Line Filter Component Board A1A1, Schematic Diagram

SECTION VI
PARTS LIST

6-1. INTRODUCTION

6-2. This parts list section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alpha-numerically by reference symbol and include all replaceable items such as electronic, electro-mechanical, and mechanical parts of the equipment. In some cases, values, ratings and manufacturer sources shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement of the part(s) removed from the equipment.

6-3. ORDERING INFORMATION

6-4. The following instructions will aid in ordering parts from the Parts Lists, tables 6-2 through 6-4.

a. Address all inquiries or orders to:

CUSTOMER SERVICE
Department 500-1
The Singer Company
Metrics Division
915 Pembroke Street
Bridgeport, Connecticut, 06608

b. Include the following information:

1) Model and Serial Number of instrument.

2) Singer Part Number.

3) Reference Symbol Number.

4) Description (as shown on list).

6-5. HOW TO USE THE PARTS LIST

6-6. Paragraphs 6-7 through 6-11 describe the use and meaning of the five columns included in the parts list (see figure 6-1).

6-7. REF SYMBOL COLUMN. The Ref Symbol Column (1, figure 6-1) contains an alpha-numerical listing of parts as they appear on equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument.

6-8. DESCRIPTION COLUMN. The Description Column (2, figure 6-1) contains the identification of component parts including all pertinent specifications and Singer part number. When the description column is used for a part which is identical to a part which has already been described; SAME AS (3) is used along with the reference symbol of the previously used part. In these instances, columns 3, 4, 5 are left blank. When the description column is used for a reference symbol for which no part exists; NOT USED (4) is placed in the column. In these instances, columns 3, 4, 5, are left blank.

6-9. MANUFACTURER'S PART NUMBER COLUMN. The Manufacturer's Part Number column (5, figure 6-1) contains the part number as designated by the manufacturer of the part.

6-10. MFR'S CODE COLUMN. The Mfr's Code column (6, figure 6-1) references the manufacturer by an assigned code number as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in H4-2, a letter code will be assigned. Table 6-1 includes the manufacturer and his code designation.

6-11. MAINT QTY COLUMN. The Maint Qty column (7, figure 6-1) contains the number of additional components recommended to keep the equipment at an optimum performance level. The recommended number of components in the Maint Qty column is based on 2000 hours of equipment operation.

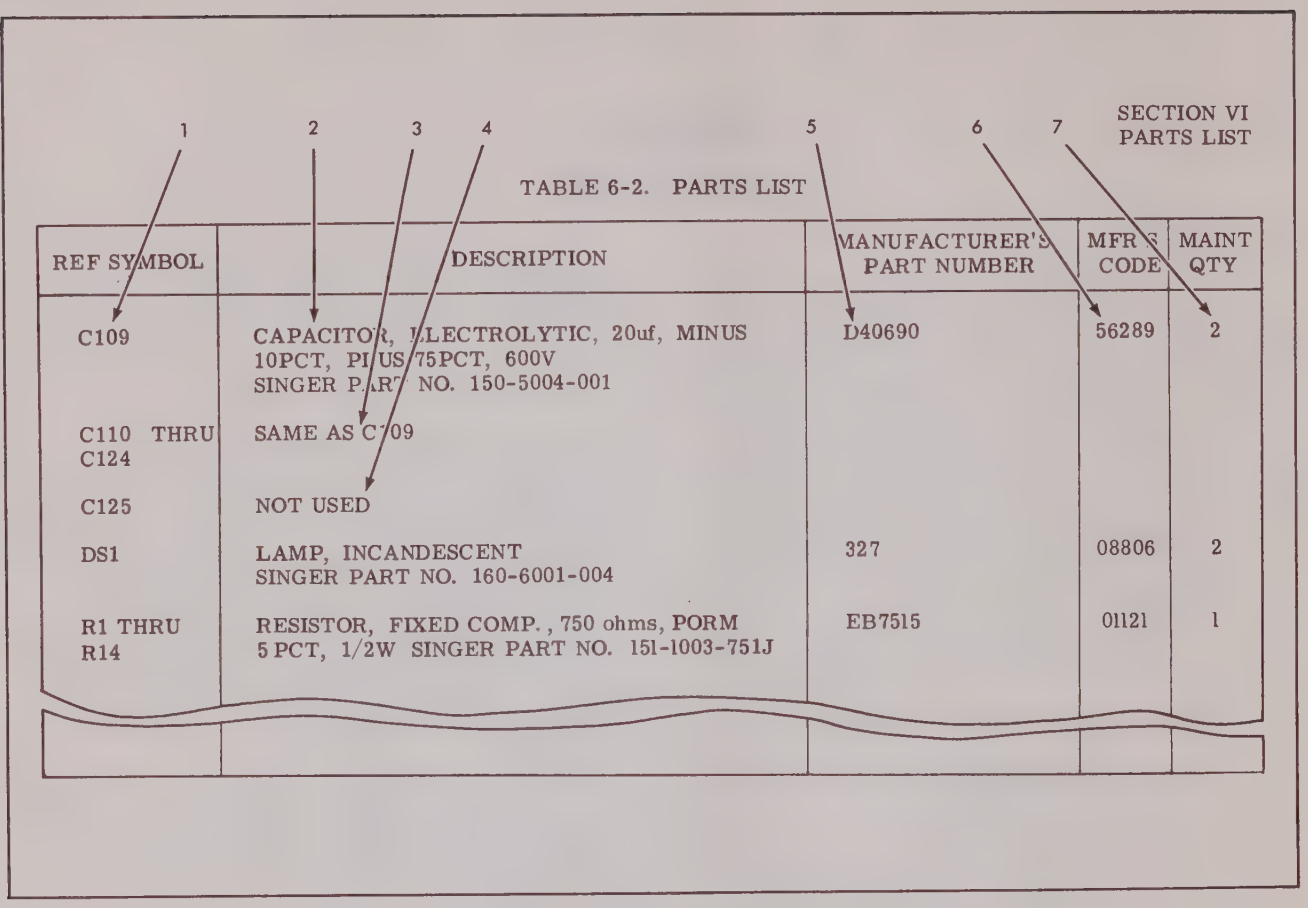


Figure 6-1. Parts List Sample

TABLE 6-1. MANUFACTURER'S CODE

Number	Name
01121	Allen-Bradley Co., Milwaukee, Wis.
01295	Texas Instruments Inc., Semiconductor-Components Division Dallas, Tex.
02660	Amphenol-Borg Electronics Corp., Maywood, Ill.
02777	Hopkins Engineering Co., San Fernando, Calif.
03636	Grayburne Corp., Yonkers, N. Y.
06978	Aladdin Electronics Division of Aladdin Industries Inc., Nashville, Tenn.
08806	General Electric Co., Miniature Lamp Department Cleveland, Ohio
09093	Solartron Inc., Anaheim, Calif.
12126	Kidco Inc., Medford, N. J.
14655	Cornell-Dubilier Electric Corp., Newark, N. J.
14841	Ward Leonard Electric Co., Hagerstown, Md.
16665	The Singer Co., Metrics Division Bridgeport, Conn.
18083	Clevite Corp., Semiconductor Division Palo Alto, Calif.
18641	Semcor Hato Rey, Puerto Rico
56289	Sprague Electric Co., North Adams, Mass.

TABLE 6-1. MANUFACTURER'S CODE (Cont'd.)

Number	Name
71400	Bussmann Mfg. Division of McGraw Edison Co., St. Louis, Mo.
71450	CTC Corp., Elkhart, Ind.
72136	Electro-Motive Mfg. Co., Inc., Willimantic, Conn.
72619	Dialight Corp., Brooklyn, N. Y.
72928	Gudeman Co., Chicago, Ill.
72971	Electrical Fittings Corp., Long Island City, N. Y.
73445	Amperex Electronic Co., Division of North American Philips Co. Inc., Hicksville, N. Y.
74970	E. F. Johnson Co., Waseca, Minn.
75915	Littelfuse Inc., Des Plaines, Ill.
76493	J. W. Miller Co., Los Angeles, Calif.
81095	Triad Transformer Corp., Venice, Calif.
81349	Military Specifications
81350	Joint Army-Navy Specifications
82389	Switchcraft Inc., Chicago, Ill.
90201	P. R. Mallory and Co. Inc., Detroit, Mich.
95105	Collins Radio Co., Newport Beach, Calif.
95146	Alco Electronics Mfg., Co., Lawrence, Mass.
95712	Dage Electric Co., Inc. Franklin, Ind.
98291	Sealectro Corp., Mamaroneck, N. Y.
99942	Hoffman Electronics Corp., Evanston, Ill.

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
CP1	LINE CORD GROUNDING ADAPTER,PART OF W1 SINGER PART NO. 556016-230	MS3106B-22-23S	81349	1
CP2	EXTENDER BOARD	103-0726-001	16665	1
DS1	LAMP,GLOW SINGER PART NO. 556002-435	NE-2J	08806	3
F1	FUSE, 1/4 AMP SINGER PART NO. 556006-010	312.250	75915	5
J1	CONNECTOR SINGER PART NO. 556016-278	AN3102A-14S-1P	81350	1
J2	CONNECTOR,BNC SINGER PART NO. 556010-159	UG-291/U	81349	1
J3	CONNECTOR,FEMALE,5 CONTACTS,WITH HOOD AND CLAMP SINGER PART NO. 556016-105	126-223	02660	1
J4	RECEPTACLE AND SWITCH ASSY,REMOTE INDICATOR	103-0725-001	16665	1
J5	CONNECTOR,FEMALE,5 PIN SINGER PART NO. 556016-024	MS3106B	02660	1
M1	METER	133-0042-001	16665	1
P1	CONNECTOR,PLUG,FEMALE,3 PINS,WITH CLAMP 168-8005-006,PART OF W1 SINGER PART NO. 556016-224	MS3106A-14S-1S	81349	1
P2	CONNECTOR,PLUG,MALE,POLARIZED,3 PINS NON-REPLACEABLE PART OF W1			
P3 AND P4	NOT USED			
P5	SAME AS J3			
P6 AND P7	CONNECTOR,COAXIAL SINGER PART NO.556016-372	53000	02660	3
P8 AND P9	SAME AS P6			
P10 AND P11	SAME AS P6			
P12 AND P13	SAME AS P6			
P14 AND P15	SAME AS P6			
P16 AND P17	SAME AS P6			
P18 AND P19	SAME AS P6			
R1	RESISTOR,FIXED,COMP., 120K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-124J	EB1245	01121	1
R2 AND R3	RESISTOR,VARIABLE, 10K OHMS,3W SINGER PART NO. 556146-182	321 SERIES	71450	1
R4	RESISTOR,VARIABLE, 10K OHMS,3W SINGER PART NO. 556146-181	321 SERIES	71450	1
R5	RESISTOR,VARIABLE, 5K OHMS,PORM 10 PCT,1/2W	151-0001-014	16665	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol		Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
R6 R7	AND	RESISTOR,FIXED,COMP., 91K OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-913J	EB9135	01121	1
R8		RESISTOR,FIXED,COMP., 6.2K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-622J	EB6225	01121	1
S1		SWITCH POWER	133-0033-001	16665	1
S2		SWITCH,TOGGLE,SPDT SINGER PART NO. 556146-408	MST-105G	95146	1
T1		TRANSFORMER,POWER	132-0036-001	16665	1
W1		LINE CORD AND PLUG ASSY	102-9125-001	16665	1
W2 W3	AND	NOT USED			
W4 W5	AND	COAXIAL CABLE ASSY	102-9106-001	16665	1
W6		COAXIAL CABLE ASSY	102-9105-002	16665	1
W7 W8	AND	COAXIAL CABLE ASSY	102-9104-001	16665	1
W9		COAXIAL CABLE ASSY	102-9106-002	16665	1
W10		COAXIAL CABLE ASSY	102-9105-001	16665	1
XDS1		SOCKET,LAMP SINGER PART NO. 556002-434	137-7336-931	72619	1
XF1		HOLDER,FUSE SINGER PART NO. 556006-015	342004	75915	1
A1		I-F SHELF ASSY	103-0556-001	16665	1
A1CR1 CR4	THRU	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556118-186	CGD-1460	18083	3
A1C1		CAPACITOR,VARIABLE, 1.8 TO 8.7 PF SINGER PART NO. 556146-329	160-305	74970	1
A1C2 C5	THRU	CAPACITOR,ELECTROLYTIC, 250 UF,PLUS 75 PCT, MINUS 10 PCT,12V SINGER PART NO. 556166-113	TE-1138	56289	1
A1C6 C7	AND	CAPACITOR,ELECTROLYTIC, 100 UF,PLUS 75 PCT, MINUS 10 PCT,15V SINGER PART NO. 556166-111	TE-1162	56289	1
A1C8		NOT USED			
A1C9		SAME AS A1C6			
A1C10		CAPACITOR,METALLIZED PAPER, 1 UF,100 V SINGER PART NO. 556120-140	1P2D	02777	1
A1E1 E19	THRU	TERMINAL,FEED-THRU SINGER PART NO. 556024-087	FT410	98291	2
A1J1 J14	THRU	CONNECTOR,BNC SINGER PART NO. 556016-248	46000	02660	3
A1J15		NOT USED			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1J16 THRU J18	SAME AS A1J1			
A1L1 THRU L4	COIL,RF, 2.5 MH SINGER PART NO. 556012-008	F-25	03636	3
A1L5	CHOKE, 4.7 MH SINGER PART NO. 556012-183	70F473A1	76493	1
A1L6 AND L7	COIL,RF, 33 MH SINGER PART NO. 556012-071	05-335	06978	1
A1R1	RESISTOR,VARIABLE, 10K OHMS,PORM 10 PCT,2W	556056-105	16665	1
A1R2 THRU R5	RESISTOR,FIXED,PREC., 1.5K OHMS,PORM 1 PCT, 1/2W SINGER PART NO. 151-1008-B1501F	C1/2E1.5KOHMPORM1PCT	12126	1
A1R6	RESISTOR,FIXED,COMP., 1K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-102J	EB1025	01121	3
A1R7	NOT USED			
A1R8	RESISTOR,FIXED,COMP., 9.1K OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-912J	EB9125	01121	1
A1R9	RESISTOR,FIXED,COMP., 18K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-183J	EB1835	01121	2
A1R10	RESISTOR,FIXED,COMP., 33K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-333J	EB3335	01121	2
A1R11	SAME AS A1R6			
A1R12	RESISTOR,FIXED,COMP., 300 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-301J	EB3015	01121	1
A1R13	RESISTOR,FIXED,COMP., 120 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-121J	EB1215	01121	1
A1S1	SWITCH I.F. SHELF	133-0028-003	16665	1
A1S2 AND S3	SWITCH I.F. SHELF	133-0028-002	16665	1
A1S4	SWITCH I.F. SHELF	133-0028-001	16665	1
A1S5	SWITCH INPUT PREAMP	133-0044-001	16665	1
A1S6	SAME AS A1S1			
A1T1	TRANSFORMER,WIDE BAND	556146-101	16665	1
A1XA1	NOT USED			
A1XA2 THRU XA11	CONNECTOR,PRINTED CIRCUIT SINGER PART NO. 556146-188	601-5062-15	72971	1
A1A1	DETECTOR LINE REGULATOR,COMPONENT BOARD	103-0754-001	16665	1
A1A1C1 THRU C6	SAME AS A1C6			
A1A1Q1	TRANSISTOR SINGER PART NO. 556017-060	2N1302	81349	2
A1A1Q2	TRANSISTOR SINGER PART NO. 556160-681	2N404	81349	2

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A1R1 AND R2	SAME AS A1R6			
A1A2	INPUT CRYSTAL FILTER,COMPONENT BOARD	103-0574-001	16665	1
A1A2C1 THRU C3	CAPACITOR,DIPPED MICA, 3900 PF,PORM 5 PCT, 100 V FACTORY SELECTED SINGER PART NO. 150-2003-392EJO	DM19E392J0100WV4CR	72136	1
A1A2C4	NOT USED			
A1A2C5	CAPACITOR,CERAMIC,0.05 UF,100 V SINGER PART NO. 556120-180	845-X5V-503Z	72982	2
A1A2C6	CAPACITOR,CERAMIC DISC, 20000 PF,PORM 10 PCT 500 V SINGER PART NO. 150-1002-203KHH	TYPE 841	72982	1
A1A2C7	SAME AS A1A2C5			
A1A2C8	CAPACITOR,METALLIZED PAPER,0.5 UF,PORM 20 PCT,200 V SINGER PART NO. 556120-128	P52DS	02777	1
A1A2Q1	TRANSISTOR SINGER PART NO. 556017-073	A307	73445	1
A1A2Q2	TRANSISTOR SINGER PART NO. 556146-162	A1380	73445	1
A1A2Q3 AND Q4	TRANSISTOR SINGER PART NO. 556160-684	2N404	81349	1
A1A2R1	RESISTOR,FIXED,COMP., 100 OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-101J	EB1015	01121	3
A1A2R2	SAME AS A1R6 FACTORY SELECTED			
A1A2R3	RESISTOR,VARIABLE, 1K OHMS,PORM 20 PCT SINGER PART NO. 556056-115	110 SERIES	71450	1
A1A2R4	RESISTOR,FIXED,COMP., 3.9K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-392J	EB3925	01121	1
A1A2R5 AND R6	RESISTOR,FIXED,COMP., 6.8K OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-682J	EB6825	01121	2
A1A2R7	SAME AS A1A2R5			
A1A2R8	NOT USED			
A1A2R9	RESISTOR,FIXED,COMP., 620 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-621J	EB6215	01121	1
A1A2R10	SAME AS A1A2R5			
A1A2R11 THRU R13	RESISTOR,FIXED,COMP., 4.7K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-472J	EB4725	01121	3
A1A2R14 AND R15	SAME AS A1R6			
A1A2T1	TRANSFORMER INPUT CRYSTAL FILTER	132-0117-001	16665	1
A1A2Y1	CRYSTAL,100004 CPS,	556146-039	16665	1
A1A2Y2	CRYSTAL,99996 CPS	556146-040	16665	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A2Y3	CRYSTAL,100034 CPS	556146-041	16665	1
A1A2Y4	CRYSTAL,99966 CPS	556146-042	16665	1
A1A2Z1 THRU Z4	FACTORY SELECTED COMPONENT			
A1A3	100-KHZ I-F CRYSTAL FILTER,COMPONENT BOARD	103-0572-001	16665	1
A1A3C1	SAME AS A1C6			
A1A3C2 THRU C4	CAPACITOR,DIPPED MICA, 1000 PF,PORM 5 PCT, 100 V FACTORY SELECTED SINGER PART NO. 150-2002-102EJO	DM15E102J0100WV4CR	72136	1
A1A3C5 AND C6	SAME AS A1A2C5			
A1A3L1	SAME AS A1L1			
A1A3Q1 AND Q2	SAME AS A1A1Q2			
A1A3R1	RESISTOR,FIXED,COMP. 10K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-103J	EB1035	01121	3
A1A3R2	SAME AS A1A2R1			
A1A3R3	RESISTOR,FIXED,COMP., 5.6K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-562J	EB5625	01121	1
A1A3R4	SAME AS A1A3R1			
A1A3R5	SAME AS A1A2R5 FACTORY SELECTED			
A1A3R6	SAME AS A1A3R1 FACTORY SELECTED			
A1A3R7	SAME AS A1A2R11			
A1A3T1	TRANSFORMER IF CRYSTAL FILTER	132-0118-001	16665	1
A1A3Y1	SAME AS A1A2Y1			
A1A3Y2	SAME AS A1A2Y2			
A1A3Y3	SAME AS A1A2Y3			
A1A3Y4	SAME AS A1A2Y4			
A1A4	100-KHZ 1-F AMPLIFIER,COMPONENT BOARD	103-0573-001	16665	1
A1A4C1	CAPACITOR,METALLIZED PAPER, 5 UF,PORM 20 PCT 200 V SINGER PART NO. 556120-128	P52DS	02777	1
A1A4C2	SAME AS A1A2C6			
A1A4C3	CAPACITOR,DIPPED MICA, 3600 PF,PORM 5 PCT, 100 V FACTORY SELECTED SINGER PART NO. 150-2003-362FJO	DM19F362J0100WV4CR	72136	1
A1A4C4 THRU C6	SAME AS A1A4C1			
A1A4C7	CAPACITOR,DIPPED MICA, 820 PF,PORM 5 PCT, 500 V SINGER PART NO. 150-2003-821FJO	DM19F821J0500WV4CR	72136	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A4L1	COIL,I.F. AMP	132-0057-001	16665	1
A1A4Q1 THRU Q4	TRANSISTOR SINGER PART NO. 556017-059	2N2188	81349	2
A1A4R1	RESISTOR,FIXED,COMP., 43K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-433J	EB4335	01121	1
A1A4R2	RESISTOR,FIXED,PREC., 5.1K OHMS,PORM 1 PCT, 1/4W SINGER PART NO. 556146-330	C1/4E5R1KOHMPORM1PCT	12126	1
A1A4R3	SAME AS A1A3R1			
A1A4R4	RESISTOR,FIXED,COMP., 560 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-561J	EB5615	01121	1
A1A4R5	RESISTOR,FIXED,COMP., 68 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-680J	EB68D5	01121	1
A1A4R6	RESISTOR,FIXED,COMP., 12K OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-123J	EB1235	01121	2
A1A4R7	SAME AS A1A3R1			
A1A4R8	SAME AS A1R6			
A1A4R9	RESISTOR,FIXED,COMP., 220 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-221J	EB2215	01121	2
A1A4R10	RESISTOR,FIXED,COMP., 1.8K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-182J	EB1825	01121	1
A1A4R11 AND R12	RESISTOR,FIXED,COMP., 1.2K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-122J	EB1225	01121	3
A1A4R13	SAME AS A1A4R11 FACTORY SELECTED			
A1A5	SAME AS A1A3			
A1A6	SAME AS A1A4			
A1A7	LOG AMPLIFIER,COMPONENT BOARD	103-0577-001	16665	1
A1A7CR1	SEMICONDUCTOR DEVICE,DIODE	132-0180-001	16665	1
A1A7CR2	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556118-170	1N7626	81349	1
A1A7CR3 THRU CR6	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556166-041	1N270	81349	1
A1A7C1	CAPACITOR,ELECTROLYTIC, 2 UF,15 V SINGER PART NO. 556120-181	TE-1149	56289	1
A1A7Q1 AND Q2	SAME AS A1A2Q2			
A1A7Q3 AND Q4	TRANSISTOR SINGER PART NO. 556017-066	2N1303	81349	1
A1A7Q5	SAME AS A1A1Q2			
A1A7Q6	TRANSISTOR SINGER PART NO. 556017-044	2N1306	81349	1
A1A7R1	RESISTOR,FIXED,COMP., 7.5K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-752J	EB7525	01121	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A7R2	NOT USED			
A1A7R3	RESISTOR,VARIABLE, 10K OHMS,PORM 10 PCT SINGER PART NO. 556146-235	110 SERIES	71450	1
A1A7R4	SAME AS A1A8R4			
A1A7R5	RESISTOR,FIXED,COMP., 47K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-473J	EB4735	01121	2
A1A7R6	RESISTOR,FIXED,COMP., 27K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-273J	EB2735	01121	1
A1A7R7	SAME AS A1R9 FACTORY SELECTED			
A1A7R8	RESISTOR,FIXED,COMP., 470 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-471J	EB4715	01121	2
A1A7R9	NOT USED			
A1A7R10	RESISTOR,FIXED,COMP., 3.6K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-362J	EB3625	01121	1
A1A7R11	RESISTOR,FIXED,COMP., 3.3K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-332J	EB3325	01121	3
A1A7R12	SAME AS A1R6			
A1A7R13	SAME AS A1A2R3			
A1A7R14	SAME AS A1A4R10			
A1A7R15	SAME AS A1A7R3			
A1A7R16	RESISTOR,FIXED,PREC., 1.8K OHMS,PORM 5 PCT, 1/8W SINGER PART NO. 151-1006-B182J	C1/8E1.8KOHMPORM5PCT	12126	1
A1A7R17	SAME AS A1A2R11			
A1A7R18	SAME AS A1A4R9			
A1A7R19	RESISTOR,FIXED,COMP., 56 OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-560J	EB5605	01121	1
A1A7R20	SAME AS A1A4R11			
A1A8	DETECTOR,COMPONENT BOARD	103-0576-001	16665	1
A1A8CR1 THRU CR8	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 557010-017	HU50	99942	1
A1A8CR9 THRU	SAME AS A1CR1			
A1A8CR13	NOT USED			
A1A8CR14	SAME AS A1CR1			
A1A8C1 THRU C4	CAPACITOR,ELECTROLYTIC, 25 UF,15V SINGER PART NO. 556074-178	TE-1157.1	56289	3
A1A8C5	CAPACITOR,CERAMIC DISC, 5000 PF,GMV,500 V SINGER PART NO. 150-1002-502PHH	TYPE 841	72982	1
A1A8C6	CAPACITOR,ELECTROLYTIC, 100 UF,MINUS 10 PCT, PLUS 75 PCT,15 V SINGER PART NO. 150-5001-101DS	TE-1162	56289	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A8Q1	TRANSISTOR SINGER PART NO. 556146-247	SM8553	01295	1
A1A8Q2 AND Q3	TRANSISTOR FACTORY SELECTED SINGER PART NO. 556146-255	2N3638	81349	1
A1A8Q4	SAME AS A1A1Q1			
A1A8R1	SAME AS A1A2R1			
A1A8R2	SAME AS A1R6			
A1A8R3	RESISTOR,VARIABLE, 10K OHMS SINGER PART NO. 556056-122	MTC-1 SERIES	90201	1
A1A8R4	RESISTOR,FIXED,COMP., 24K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-243J	EB2435	01121	2
A1A8R5	SAME AS A1A7R5			
A1A8R6	RESISTOR,FIXED,COMP., 3K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-302J	EB3025	01121	1
A1A8R7	SAME AS A1R6			
A1A8R8	RESISTOR,FIXED,COMP., 30K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-303J	EB3035	01121	1
A1A8R9	RESISTOR,FIXED,COMP., 20K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-203J	EB2035	01121	1
A1A8R10	SAME AS A1A8R4			
A1A8R11	SAME AS A1A2R11			
A1A8R12	SAME AS A1A7R11			
A1A8R13	RESISTOR,FIXED,COMP., 2K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-202J	EB2025	01121	3
A1A8R14	RESISTOR,FIXED,COMP., 2.7K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-272J	EB2725	01121	1
A1A8R15	RESISTOR,FIXED,COMP., 1.6K OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-162J	EB1625	01121	1
A1A8R16	NOT USED			
A1A8R17	SAME AS A1R9			
A1A8R18	SAME AS A1R10			
A1A8R19 AND R20	SAME AS A1A3R1			
A1A8R21	RESISTOR,FIXED,COMP., 22 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-220J	EB2205	01121	1
A1A9	WIDE BAND DRIVER AMPLIFIER,COMPONENT BOARD	103-0575-001	16665	1
A1A9CR1 THRU CR5	SAME AS A1CR1			
A1A9C1	CAPACITOR,ELECTROLYTIC, 200 UF,3V SINGER PART NO. 556074-185	TE-1064	56289	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A9C2	CAPACITOR,CERAMIC DISC, 10000 PF,GMV,500 V SINGER PART NO. 150-1002-103PHF	TYPE 811	72982	1
A1A9C3	NOT USED			
A1A9C4 THRU C6	SAME AS A1C6			
A1A9C7 AND C8	SAME AS A1A9C2			
A1A9C9	CAPACITOR,ELECTROLYTIC, 20 UF,MINUS 10 PCT, PLUS 75 PCT,15 V SINGER PART NO. 150-5001-200DS	TE-1157	56289	1
A1A9C10	CAPACITOR,ELECTROLYTIC, 10 UF,MINUS 10 PCT, PLUS 75 PCT,6 V SINGER PART NO. 150-5001-100BS	TE-1155	56289	1
A1A9C11	CAPACITOR,DIPPED MICA, 100 PF,PORM 5 PCT, 500 V SINGER PART NO. 150-2002-101EJO	DM15E101J0500WV4CR	72136	1
A1A9C12	CAPACITOR,DIPPED MICA, 62 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-620EJO	DM15E620J0500WV4CR	72136	1
A1A9Q1	SAME AS A1A2Q2			
A1A9Q2	SAME AS A1A4Q1			
A1A9Q3 AND Q4	SAME AS A1A1Q1			
A1A9Q5 THRU Q7	SAME AS A1A2Q3			
A1A9Q8	SAME AS A1A7Q6			
A1A9Q9	TRANSISTOR SINGER PART NO. 556160-683	2N404	81349	1
A1A9R1	SAME AS A1A3R3			
A1A9R2	SAME AS A1A7R8			
A1A9R3	SAME AS A1A7R1			
A1A9R4	SAME AS A1A8R13			
A1A9R5	RESISTOR,FIXED,COMP., 430 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-431J	EB4315	01121	1
A1A9R6	SAME AS A1R10			
A1A9R7	SAME AS A1A2R11			
A1A9R8	SAME AS A1A8R6 FACTORY SELECTED			
A1A9R9	SAME AS A1A2R11			
A1A9R10	SAME AS A1A2R1			
A1A9R11	SAME AS A1A8R13 FACTORY SELECTED			
A1A9R12 AND R13	RESISTOR,VARIABLE, 3K OHMS FACTORY SELECTED SINGER PART NO. 556056-131	110 SERIES	71450	1
A1A9R14	SAME AS A1A7R11			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A9R15	SAME AS A1A3R1			
A1A9R16	RESISTOR,FIXED,COMP., 5.1K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-512J	EB5125	01121	1
A1A9R17	RESISTOR,FIXED,COMP., 15K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-153J	EB1535	01121	1
A1A9R18	RESISTOR,FIXED,COMP., 750 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-751J	EB7515	01121	1
A1A9R19	SAME AS A1A8R13			
A1A9R20	SAME AS A1R6			
A1A9R21	SAME AS A1A2R11			
A1A9R22	SAME AS A1A4R9			
A1A9R23 AND R24	SAME AS A1A2R1			
A1A9R25 AND R26	RESISTOR,FIXED,COMP., 10 OHMS,PORM 5 PCT, 1/2W SINGER PART NO. 151-1003-100J	EB1005	01121	1
A1A9R27	SAME AS A1A2R11			
A1A9R28	SAME AS A1A2R1			
A1A10	20-KHZ LOW-PASS FILTER AND BROADBAND LOW-NOISE PREAMPLIFIER,COMPONENT BOARD	103-0571-001	16665	1
A1A10CR1	SAME AS A1A7CR2			
A1A10C1 AND C2	CAPACITOR,METALIZED PAPER, 0.5 UF,PORM 5 PCT 200 V SINGER PART NO. 150-3003-002	P52DSC	02777	1
A1A10C3	CAPACITOR,ELECTROLYTIC, 100 UF,15V SINGER PART NO. 556146-334	TSD5-15-107	18641	1
A1A10C4	CAPACITOR,ELECTROLYTIC, 27 UF,15V SINGER PART NO. 556146-332	TSD3-15-276	18641	1
A1A10C5	CAPACITOR,DIPPED MICA, 250 PF,PORM 5 PCT, 500 V SINGER PART NO. 150-2002-251CJN	DM15C251J0500WV4CR	72136	1
A1A10C6	CAPACITOR,ELECTROLYTIC, 10 UF,10V SINGER PART NO. 556146-331	TSDI-10-106	18641	1
A1A10C7	CAPACITOR,ELECTROLYTIC, 100 UF,6V SINGER PART NO. 556146-333	TSD4-6-107	18641	1
A1A10Q1	TRANSISTOR SINGER PART NO. 556017-077	2N2386	81349	1
A1A10Q2 AND Q3	SAME AS A1A2Q1			
A1A10Q4	SAME AS A1A9Q9			
A1A10Q5	SAME AS A1A9Q2			
A1A10R1	RESISTOR,FIXED,COMP., 100K OHMS,PORM 5 &CT 1/2W SINGER PART NO. 151-1003-104J	EB1045	01121	1
A1A10R2	SAME AS A1A4R6			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A10R3	RESISTOR,FIXED,COMP.,, 6K OHMS,PORM 5 PCT 1/2W FACTORY SELECTED SINGER PART NO. 151-1003-602J	EB6025	01121	1
A1A10R4	SAME AS A1A2R1			
A1A10R5	SAME AS A1A7R8			
A1A10R6	RESISTOR,FIXED,COMP.,, 1.5K OHMS,PROM 5 PCT 1/2W SINGER PART NO. 151-1003-152J	EB1525	01121	1
A1A10R7	SAME AS A1A3R1			
A1A10R8	RESISTOR,FIXED,COMP.,, 2.4K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-242J	EB2425	01121	1
A1A10R9	SAME AS A1A10R6			
A1A10R10	RESISTOR,FIXED,COMP.,, 2K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-202J	CB2025	01121	1
A1A10R11	SAME AS A1A2R11			
A1A10R12	SAME AS A1A2R1			
A1A10R13	SAME AS A1A2R11			
A1A10R14 AND R15	SAME AS A1A7R8			
A1A10R16	RESISTOR,FIXED,COMP.,, 1 MEGOHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-106J	EB1065	01121	1
A1A10A1	15-KHZ LOW-PASS FILTER,COMPONENT BOARD	103-1033-001	16665	1
A1A10A1C1	CAPACITOR,DIPPED MICA, 22 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-220CJN	DM15C220J0500WV4CR	72136	1
A1A10A1C2 AND C3	CAPACITOR,DIPPED MICA, 82 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-820CJN	DM15C820J0500WV4CR	72136	1
A1A10A1L1	CHOKE, 470 MH SINGER PART NO. 556012-180	14-476	06978	1
A1A10A1L2	CHOKE, 680 MH SINGER PART NO. 556012-179	14-686	06978	1
A1A10A1L3	CHOKE, 800 MH SINGER PART NO. 556012-181	14-806	06978	1
A1A10A1L4	SAME AS A1A10A1L2			
A1A10A1L5	SAME AS A1A10A1L1			
A1A10A1R1 AND R2	RESISTOR,FIXED,COMP.,, 22K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-223J	CB2235	01121	1
A1A10A1R3	RESISTOR,FIXED,COMP.,, 470K OHMS,PORM 5 PCT, 1/4W SINGER PART NO. 151-1002-474J	CB4745	01121	1
A1A10A1R4	RESISTOR,FIXED,COMP.,, 750K OHMS,PORM 5 PCT, 1/4W FACTORY SELECTED SINGER PART NO. 151-1002-754J	CB7545	01121	1
A1A11	WIDE BAND AMPLIFIER,COMPONENT BOARD	103-0569-001	16665	1
A1A11CR1	SAME AS A1A7CR3			
A1A11C1	SAME AS A1C6			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A1A11C2	CAPACITOR,ELECTROLYTIC, 320 UF,6.4V SINGER PART NO. 556146-406	C426AR/C320	73445	1
A1A11C3	SAME AS A1C6			
A1A11C4	SAME AS A1A8C1			
A1A11C5	CAPACITOR,DIPPED MICA, 1500 PF,PORM 5 PCT, 100 V SINGER PART NO. 150-2003-152FJ0	DM19F152J0100WV4CR	72136	1
A1A11C6	SAME AS A1A9C11			
A1A11C7	CAPACITOR,DIPPED MICA, 47 PF,PORM 5 PCT,500V SINGER PART NO. 150-2002-470EJ0	DM15E470J0500WV4CR	72136	1
A1A11C8	SAME AS A1A9C11			
A1A11C9 AND C10	SAME AS A1A8C1			
A1A11L1	SAME AS A1L5			
A1A11L2	INDUCTOR,RF, 68 MH,PORM 10 PCT SINGER PART NO. 156-7003-001	83-685	06978	1
A1A11Q1 AND Q2	SAME AS A1A4Q1			
A1A11Q3	SAME AS A1A1Q1			
A1A11Q4 AND Q5	SAME AS A1A1Q2			
A1A11R1	RESISTOR,FIXED,PREC., 600 OHMS,PORM 1 PCT, 1/8W SINGER PART NO. 151-1006-B6000F	C1/8E6000HMPORM1PCT	12126	1
A1A11R2	SAME AS A1A7R5			
A1A11R3	SAME AS A1A9R17			
A1A11R4	SAME AS A1A2R1			
A1A11R5	SAME AS A1A2R5 FACTORY SELECTED			
A1A11R6	SAME AS A1R6			
A1A11R7	SAME AS A1A2R11			
A1A11R8	RESISTOR,FIXED,COMP., 22K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-223J	EB2235	01121	1
A1A11R9	SAME AS A1A2R11			
A1A11R10	SAME AS A1A3R3			
A1A11R11	RESISTOR,FIXED,COMP., 47 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-470J	EB4705	01121	2
A1A11R12	SAME AS A1A4R6			
A1A11R13	SAME AS A1A2R11			
A1A11R14	SAME AS A1A4R6			
A1A11R15	SAME AS A1A2R11			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2	ATTENUATOR AND 1-KHZ CALIBRATION OSCILLATOR ASSY	103-0554-001	16665	1
A2C1	CAPACITOR,CERAMIC, 1000 PF,PORM 20 PCT,500V SINGER PART NO. 556060-071	TYPE X5S	72982	1
A2C2	CAPACITOR,VARIABLE, 1.5 TO 7 PF,NPO SINGER PART NO. 556122-076	557-000-NPO	72982	1
A2E1 THRU E7	CONNECTOR -TERMINATION- BULKHEAD MOUNTING SINGER PART NO. 168-4036-001	1-413-1 /NT-34	95712	1
A2P1 THRU P6	SAME AS P6			
A2R1	RESISTOR,FIXED,PREC., 90K OHMS,PORM .25 PCT 1/2W SINGER PART NO. 151-2012-A9002C	MI/2E90KOHM, .25PCT	12126	1
A2R2	RESISTOR,FIXED,PREC., 900 OHMS,PORM .25 PCT, 1/2W SINGER PART NO. 151-2012-A9000C	MI/2E9000HM, .25PCT	12126	1
A2R3	RESISTOR,FIXED,PREC., 10K OHMS,PORM .25 PCT, 1/2W SINGER PART NO. 151-2012-A1002C	MI/2E10KOHM, .25PCT	12126	1
A2R4	RESISTOR,FIXED,PREC., 100 OHMS,PORM .25 PCT, 1/2W SINGER PART NO. 151-2012-A1000C	MI/2E100OHM, .25PCT	12126	1
A2R5	RESISTOR,FIXED,PREC., 59.4K OHMS,PORM .25, PCT,1/2W SINGER PART NO. 151-2012-A5942C	MI/2E59,4KOHM,.25PCT	12126	1
A2R6	RESISTOR,FIXED,PREC., 606 OHMS,PORM .25 PCT, 1/2W SINGER PART NO. 151-2012-A6060C	MI/2E6060HM, .25PCT	12126	1
A2R7	RESISTOR,FIXED,PREC., 5.4K OHMS,PORM .25 PCT 1/2W SINGER PART NO. 151-2012-A5401C	MI/2E5.4KOHM, .25PCT	12126	1
A2R8	RESISTOR,FIXED,PREC., 666 OHMS,PORM .25 PCT, 1/2W SINGER PART NO. 151-2012-A6660C	MI/2E6660HM, .25PCT	12126	1
A2R9	RESISTOR,FIXED,PREC., 4.5K OHMS,PORM .25 PCT 1/2W SINGER PART NO. 151-2012-A4501C	MI/2E4.5KOHM, .25PCT	12126	1
A2R10	RESISTOR,FIXED,PREC., 504 OHMS,PORM .25 PCT, 1/2W SINGR 1/2W SINGER PART NO. 151-2012-A5040C	MI/2E5040HM, .25PCT	12126	1
A2R11	RESISTOR,FIXED,PREC., 51 OHMS,PORM .25 PCT, 1/2W SINGER PART NO. 151-2012-A51RC	MI/2E51OHMPORM.25PCT	12126	1
A2R12	SAME AS A2R9			
A2R13	SAME AS A2R11			
A2R14	SAME AS A2R10			
A2R15	RESISTOR,VARIABLE, 50 OHMS,PORM 20 PCT,1/2W	151-0001-045	16665	1
A2S1	SWITCH WIDE BAND	133-0024-001	16665	1
A2S2	SWITCH NARROW BAND	133-0025-001	16665	1
A2A1	1-KHZ CALIBRATION OSCILLATOR,COMPONENT BOARD	103-0565-001	16665	1
A2A1CR1	SAME AS A1A7CR2			
A2A1C1	SAME AS A1A2C8			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A2A1C2	CAPACITOR,MYLAR,0.047 UF,PORM 5 PCT,150V SINGER PART NO. 556120-081	338Y473J	72928	1
A2A1C3	SAME AS A1A2C8			
A2A1C4	CAPACITOR,FOIL,0.033 UF,PORM 10 PCT,200V SINGER PART NO. 556166-102	148P33392	56289	1
A2A1C5	SAME AS A1A8C1			
A2A1C6	CAPACITOR,ELECTROLYTIC, 200 UF,15V SINGER PART NO. 556074-012	TE-1164	56289	1
A2A1L1	CHOKE, 0.5 HY SINGER PART NO. 556012-188	MP-930-27A	95105	1
A2A1Q1	SAME AS A1A1Q2			
A2A1R1	SAME AS A1A11R8			
A2A1R2	RESISTOR,FIXED,COMP., 2.2K OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-222J	EB2225	01121	2
A2A1R3	RESISTOR,FIXED,COMP., 330 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-331J	EB3315	01121	1
A2A1R4	SAME AS A1A8R13 FACTORY SELECIED			
A2A1R5	SAME AS A1A10R1			
A2A1R6	RESISTOR,VARIABLE, 1K OHM SINGER PART NO. 556146-214	MTC-1 SERIES	90201	1
A2A1R7	SAME AS A1A10R6			
A2A1R8	SAME AS A1R6			
A3	BFO AND AUDIO ASSY	103-0558-001	16665	1
A3E1 AND E2	SAME AS A1E1			
A3J1 THRU J3	SAME AS A1J1			
A3J4	CONNECTOR,BNC SINGER PART NO. 556010-158	UG-290/U	81349	1
A3J5	JACK,PHONE SINGER PART NO. 556010-247	MT-JAX-LMT337	82389	1
A3R1	SAME AS A1A7R5			
A3R2	RESISTOR,VARIABLE, 5K OHMS,3W SINGER PART NO. 556146-180	321 SERIES	71450	1
A3S1	SWITCH BEAT FREQUENCY OSCILLATOR	133-0054-001	16665	1
A3XA1 AND XA2	CONNECTOR,PRINTED CIRCUIT SINGER PART NO. 556146-189	600-S062-10	72971	1
A3A1	BFO MIXER COMPONENT BOARD	106-0126-001	16665	1
A3A1C1	SAME AS A1A2C5			
A3A1C2	SAME AS A1A9C2			
A3A1C3	CAPACITOR,DIPPED MICA, 1100 PF,PORM 1 PCT, 100 V SINGER PART NO. 150-2003-112FFO	DM19F112F0100WV4CR	72136	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A3A1C4	SAME AS A1A8C5			
A3A1C5	SAME AS A1A8C1			
A3A1C6	NOT USED			
A3A1C7	SAME AS A1A7C1			
A3A1C8	SAME AS A1A8C1			
A3A1L1	SAME AS A1L1			
A3A1L2	CHOKE, 22 MH SINGER PART NO. 556012-178	70F222AL	76493	1
A3A1L3	SAME AS A1L1			
A3A1Q1 AND Q2	SAME AS A1A4Q1			
A3A1R1	SAME AS A1R9			
A3A1R2	SAME AS R8			
A3A1R3	SAME AS A1A7R11			
A3A1R4	SAME AS A1A4R11			
A3A1R5	SAME AS A1A4R9			
A3A1R6	NOT USED			
A3A1R7	SAME AS A1R10			
A3A1R8	SAME AS A1A7R11			
A3A1R9	SAME AS A1A2R11			
A3A1Y1	CRYSTAL, 100600 CPS	556012-184	16665	1
A3A2	AUDIO OUTPUT AMPLIFIER,COMPONENT BOARD	106-0128-001	16665	1
A3A2CR1	SAME AS A1CR1			
A3A2C1	SAME AS A1A8C1			
A3A2C2	CAPACITOR,DIPPED MICA, 1000 PF,PORM 5 PCT, 500 V SINGER PART NO. 150-2002-102FJO	DM19F102J0500WV4CR	72136	1
A3A2C3	SAME AS A1A8C1			
A3A2C4	SAME AS A1C6			
A3A2C5 AND C6	SAME AS A1A2C5			
A3A2L1 AND L2	SAME AS A1L1			
A3A2Q1	SAME AS A1A1Q2			
A3A2Q2	TRANSISTOR SINGER PART NO. 556017-064	2N696	81349	1
A3A2Q3	SAME AS A3A2Q2			
A3A2R1	SAME AS A2A1R2			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A3A2R2	SAME AS A1A3R1			
A3A2R3	RESISTOR,FIXED,COMP., 360 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-361J	EB3615	01121	1
A3A2R4	SAME AS A1A10R8			
A3A2R5 AND R6	SAME AS A1A11R11			
A3A2R7	SAME AS A1A8R8			
A3A2T1	TRANSFORMER SINGER PART NO. 556020-227	TY35X	81095	1
A4	INPUT IMPEDANCE SELECTOR ASSY	103-0557-001	16665	1
A4C1	CAPACITOR,DIPPED MICA, 180 PF,PORM 5 PCT, 500 V SINGER PART NO. 150-2003-181FJO	DM19F181J0500WV4CR	72136	1
A4C2	CAPACITOR,DIPPED MICA, 500 PF,PORM 5 PCT, 500 V SINGER PART NO. 150-2003-501FJO	DM19F501J0500WV4CR	72136	1
A4E1	SAME AS A2E1			
A4P1 AND P2	SAME AS P6			
A4R1 THRU R3	NOT USED			
A4R4	SAME AS R2			
A4R5	SAME AS A1A8R6			
A4R6	SAME AS A1A8R4			
A4R7	RESISTOR,VARIABLE, 1K OHM,3W SINGER PART NO. 556146-354	321 SERIES	71450	1
A4S1	SWITCH IMPEDANCE SELECTOR	133-0023-001	16665	1
A4T1	TRANSFORMER,INPUT IMPEDANCE MATCHING	132-0120-001	16665	1
A5	TUNABLE LOCAL OSCILLATOR ASSY	103-0553-001	16665	1
A5C1	CAPACITOR,VARIABLE, 16 TO 250 PF	149-0061-001	16665	1
A5C2	CAPACITOR,CERAMIC DISC, 110 PF,PORM 5 PCT, 500 V SINGER PART NO. 150-1001-111JKE	TYPE 871	72982	1
A5C3	CAPACITOR,VARIABLE, 32 TO 50 PF SINGER PART NO. 556060-173	148-4	74970	1
A5C4 AND C5	SAME AS A1C2			
A5C6	NOT USED			
A5C7	CAPACITOR,VARIABLE, 2.3 TO 15 PF SINGER PART NO. 556146-328	S148-1	74970	1
A5C8 AND C9	SAME AS A5C2			
A5J1	CONNECTOR,MALE,5 CONTACTS,WITH LOCKING CLIP, SINGER PART NO. 556010-062	126-216	02660	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A5J2 AND J3	SAME AS A1J1			
A5L1 AND L2	SAME AS A1L1			
A5L3	COIL ASSY	103-0766-001	16665	1
A5L4	COIL,VARIABLE, 300 TO 580 UH SINGER PART NO. 556146-367	42A474CB1	76493	1
A5R1	RESISTOR,VARIABLE, 5K OHMS,PORM 5 PCT	149-0059-001	16665	1
A5R2	SAME AS A1A4R9			
A5XA1	SAME AS A3XA1			
A5A1	TUNABLE LOCAL OSCILLATOR,COMPONENT BOARD	103-0564-001	16665	1
A5A1CR1 THRU CR3	SAME AS A1CR1			
A5A1C1	SAME AS A1A11C7			
A5A1C2	SAME AS A1A2C8			
A5A1C3	SAME AS A1A3C2			
A5A1C4	SAME AS A1A2C5			
A5A1C5 AND	SAME AS A1A2C8			
A5A1C7	SAME AS A1A7C1			
A5A1C8	SAME AS A1A2C5			
A5A1Q1	SAME AS A1A4Q1			
A5A1Q2	SAME AS A1A1Q1			
A5A1Q3	SAME AS A1A1Q2			
A5A1Q4	SAME AS A1A1Q1			
A5A1Q5	SAME AS A1A9Q8			
A5A1Q6	SAME AS A1A1Q2			
A5A1Q7	SAME AS A1A9Q8			
A5A1R1	SAME AS A1A11R8			
A5A1R2	SAME AS A1A8R13			
A5A1R3 AND R4	SAME AS A1A10R6			
A5A1R5	SAME AS A1A3R1			
A5A1R6	SAME AS A1A3R1			
A5A1R7	SAME AS A1A7R6			
A5A1R8	SAME AS A1A10R8			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A5A1R9	SAME AS A1A3R1 FACTORY SELECTED			
A5A1R10 AND R11	SAME AS A1A2R11			
A5A1R12 AND R13	RESISTOR,FIXED,COMP., 33 OHMS,PORM 5 PCT 1/2W SINGER PART NO. 151-1003-330J	EB3305	01121	1
A5A1R14	SAME AS A1A9R17 FACTORY SELECTED			
A5A1R15 AND R16	SAME AS A1A7R11			
A5A1R17	SAME AS A1A8R13			
A5A1R18	SAME AS A1A10R6			
A5A1R19	SAME AS A1R6			
A5A1R20	SAME AS A1A2R11			
A5A1R21	SAME AS A1A8R13			
A5A1T1	TRANSFORMER, LOCAL OSCILLATOR	132-0107-001	16665	1
A6	VOLTAGE REGULATOR ASSY	103-0559-001	16665	1
A6CR1 AND CR2	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556146-106	1N1596	81349	1
A6CR3 AND CR4	NOT USED			
A6CR5	SAME AS A1A7CR3			
A6C1 AND C2	SAME AS A1C6			
A6F1 AND F2	FUSE,DELAY, 3/8 AMP SINGER PART NO. 556006-008	MDL 3/8	71400	5
A6J1	SAME AS A5J1			
A6P1	SAME AS J3			
A6P2	CONNECTOR,MALE,5 CONTACTS,WITH HOOD AND CLAMP SINGER PART NO. 556016-087	126-217	02660	1
A6Q1 THRU Q3	TRANSISTOR SINGER PART NO. 556017-025	2N242	81349	1
A6Q4	TRANSISTOR SINGER PART NO. 556146-012	2N1483	81349	1
A6R1 AND R2	RESISTOR,VARIABLE, 2.5K OHMS,PORM 10 PCT,2W SINGER PART NO. 556056-104	1RCWPRC2500	71450	1
A6S1	SWITCH DC POWER	133-0029-001	16665	1
A6XF1 AND XF2	HOLDER,FUSE SINGER PART NO. 556006-002	357002	75915	1
A6A1	VOLTAGE REGULATOR,COMPONENT BOARD	103-0560-001	16665	1
A6A1CR1	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556118-171	IN751	81349	1

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A6A1CR2	SAME AS A1A7CR2			
A6A1CR3	SAME AS A6A1CR1			
A6A1CR4	SAME AS A1A7CR2			
A6A1C1	NOT USED			
A6A1C2	SAME AS A1A8C1			
A6A1C3	SAME AS A1A8C1			
A6A1C4	NOT USED			
A6A1C5	SAME AS A1A8C1			
A6A1C6	SAME AS A1A8C1			
A6A1Q1 AND Q2	SAME AS A1A1Q2			
A6A1Q3 AND Q4	SAME AS A1A1Q1			
A6A1R1	NOT USED			
A6A1R2	SAME AS A1A4R4			
A6A1R3	RESISTOR,FIXED,COMP., 470 OHMS,PORM 5 PCT 1W SINGER PART NO. 151-1004-471J	GB4715	01121	1
A6A1R4	RESISTOR,FIXED,COMP., 51 OHMS,PORM 5 PCT 1W SINGER PART NO. 151-1004-510J	GB5105	01121	1
A6A1R5	RESISTOR,FIXED,COMP., 100 OHMS,PORM 5 PCT 1W SINGER PART NO. 151-1004-101J	GB1015	01121	1
A6A1R6	RESISTOR,FIXED,WIREWOUND, 56 OHMS,PORM 5 PCT 5W SINGER PART NO. 556043-096	5X56	14841	1
A6A1R7	SAME AS A1A7R11			
A6A1R8	SAME AS A1A8R14			
A6A1R9	SAME AS A1A4R11			
A6A1R10	SAME AS R1 FACTORY SELECTED			
A6A1R11 AND R12	SAME AS A2A1R2			
A6A1R13	NOT USED			
A6A1R14	SAME AS A1A4R4			
A6A1R15	SAME AS A6A1R3			
A6A1R16	SAME AS A6A1R4			
A6A1R17	SAME AS A6A1R5			
A6A1R18	SAME AS A6A1R6			
A6A1R19	SAME AS A1A7R11			
A6A1R20	SAME AS A1A8R14			

TABLE 6-2. PARTS LIST (NF-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A6A1R21	SAME AS A1A4R11			
A6A1R22	SAME AS R1 FACTORY SELECTED			
A6A1R23 AND R24	SAME AS A2A1R2			
A7	D-C POWER SUPPLY,COMPONENT BOARD	103-0561-001	16665	1
A7CR1 THRU CR4	SEMICONDUCTOR DEVICE,DIODE SINGER PART NO. 556118-093	CER500	09093	1
A7C1	CAPACITOR,ELECTROLYTIC, 250 UF,50V SINGER PART NO. 556074-017	BR250-50	14655	1
A7C2	CAPACITOR,ELECTROLYTIC, 500 UF,50V SINGER PART NO. 556074-035	BR500-50	14655	1
A7C3	SAME AS A7C1			
A7C4	SAME AS A7C2			
A7R1	RESISTOR,FIXED,COMP., 10 OHMS,PORM 5 PCT 2W SINGER PART NO. 151-1005-100J	HB1005	01121	1
A7R2	RESISTOR,FIXED,COMP., 30 OHMS,PORM 5 PCT 2W SINGER PART NO. 151-1005-300J	HB3005	01121	1
A7R3	SAME AS A7R1			
A7R4	SAME AS A7R2			

TABLE 6-3. PARTS LIST (KT-315)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
AC-315	ACCESSORY CARRYING CASE	140-0001-001	16665	
BG-315	TRIPOD BAG	556001-288	16665	
CB-6-315	ANTENNA CABLE,6 FOOT	102-9101-002	16665	
CB-30-315	ANTENNA CABLE,30 FOOT	102-9101-001	16665	
EA-315	EARPHONES	556001-200	16665	
LW-315	LOOP ANTENNA	102-0018-003	16665	
TP-315-A	TRIPOD	556001-287	16665	